Appendix A

Notice of Preparation and Scoping Comments

CAL MARITIME

California State University Maritime Academy

NOTICE OF PREPARATION OF AN ENVIRONMENTAL IMPACT REPORT

Waterfront Master Plan

California State University Maritime Academy

Date: December 1, 2022

To: State Clearinghouse, Responsible Agencies, Trustee Agencies, Interested Parties, and Individuals

Lead Agency: California State University Board of Trustees

Public Review Period: December 1, 2022 – January 3, 2023

Purpose of the Notice: The intent of this Notice of Preparation (NOP) is to inform agencies and interested parties that the California State University Maritime Academy (Cal Maritime) is preparing a Draft Environmental Impact Report (EIR) for the Cal Maritime Waterfront Master Plan (proposed project). The California State University (CSU) Board of Trustees (Board) is the lead agency pursuant to the California Environmental Quality Act (CEQA) and as such is responsible for complying with the provisions of CEQA.

This NOP has been prepared pursuant to Sections 15082 and 15083 of the State CEQA Guidelines and initiates a public scoping period that will assist Cal Maritime in the preparation of the Draft EIR. The purpose of the NOP is to provide potential responsible agencies, trustee agencies, and other interested parties with a description of the project and its potential environmental impacts and to provide the opportunity to submit input regarding the scope and content of the EIR, including possible environmental impacts, mitigation measures, and alternatives.

The 30-day public scoping period commenced on December 1, 2022 and will conclude on January 3, 2023.

Project Location: The approximately 22-acre project site (Assessor's parcel number (APN) 006-209-0030) is located within the Cal Maritime campus boundaries in the City of Vallejo, at the foot of the Carquinez Bridge in southwest Solano County. The regional location is shown in Figure 1. The approximately half-mile of waterfront is the campus's dominant natural feature and the main focal point of Cal Maritime instruction and activities.

The project site boundaries are shown in Figure 2. The main pier and berth for the existing Training Ship Golden Bear (TSBG) and adjacent boat basin are major features of the southeastern edge of the waterfront. Existing uses are shown in Figure 3. The entirety of the Cal Maritime waterfront and in-water marine structures comprise the total planning area of the proposed project. Beyond the campus, surrounding uses and points of interest include residential uses (the Crystal Pointe neighborhood) northwest of the campus, Carquinez Bridge Vista Point just east of the campus, and

Livingstone's Inspiration Park and Bay Area Ridge Trail to the east on the far side of I-80. Figure 4 shows the project vicinity.

Background and Purpose of the Waterfront Master Plan: The waterfront is the most prominent feature of the Cal Maritime campus and supports teaching and recreational programming. Facilities include an approximately 2,640-foot-long publicly accessible waterfront promenade and public parking, an operational port for small craft, an operating pier, and the TSGB, a 500-foot training vessel used for cadet instruction and onboard living as part of that training.

The waterfront has never undergone comprehensive master planning and instead has evolved over time in response to programmatic needs. The condition of many of the waterfront facilities and infrastructure varies from good to poor and extensive repairs or upgrades are needed. Cal Maritime also anticipates academic and operational changes over the next 5-10 years that elevate the need for a waterfront master plan. A critical component of the proposed project is preparation for arrival of the next generation of state-of-the-art training ship: the National Security Multi-Mission Vessel (NSMV). Cal Maritime's new training vessel will be the fifth in a fleet of ships specifically designed for U.S. State Maritime Academies and will replace the TSGB. Its arrival is currently scheduled for late 2026.

Arrival of Cal Maritime's NSMV will elevate the level of training and shipboard experience for cadets. Moreover, since these vessels remain part of the Maritime Administration's (MARAD) National Defense Reserve Fleet, they may be called into specialized national service. The ship's dual roles in training and service place unique demands on the landside and in-water infrastructure supporting its future Cal Maritime home port.

The Waterfront Master Plan is intended to identify and integrate key projects into a comprehensive plan to guide redevelopment of Cal Maritime's in-water and landside facilities and infrastructure to support academic and port operations, public access, environmental factors, and long-term resiliency. Implementation of the proposed project would occur in three phases spanning 10 years.

Project Description: The proposed project seeks to implement improvements along Cal Maritime's waterfront and identifies three phases of development over the next 10+ years, each of which is summarized below. Figure 5 provides a conceptual rendering of the Waterfront Master Plan and Figure 6 illustrates all of the individual components of the proposed Waterfront Master Plan at full completion.

Phase One of the project is essential to fulfilling Cal Maritime readiness for NSMV arrival and would include expansion of the main pier to a new length of approximately 471 feet and widening of the linking trestle to approximately 70 feet; and installation of a series slips and berthing areas for Cal Maritime's fleet of work boats, tugboats, small passenger boats, and other vessels currently located offsite and/or planned for future acquisition. Phase One also includes improvements to landside operational facilities and infrastructure. As shown on Figure 7, Phase One components would include:

- Main pier expansion or replacement and temporary relocation of the Training Ship Golden Bear (TSBG) to a nearby location to be determined
- Dredging of main pier berth pocket and existing boat basin (Basin 1) including potential maintenance dredging approximately every five years
- Installation of navigation aids

- New floating and training docks at Basin 1
- Expansion and upgrades of the marine yard, including new retaining wall
- Utilities relocation and upgrades
- Arrival and operation of NSMV

It is anticipated that the level of design and engineering of Phase One components will be sufficient to support project-specific analysis.

Phase Two of the project would focus on expansion of cadet instruction and marine programs including expansion of the basin to create Basin 2 through development of a new breakwater and installation of additional slips and berths for Cal Maritime's boat fleet, and other vessels currently located offsite and/or planned for future acquisition. A total of 10,800 square feet of additional floating slips/berthing area (approximately 26 slips/berthing positions) would be provided in Basin 2. Renovation of the boathouse would also occur in Phase Two. As shown on Figure 8, Phase Two components would include:

- Seismic retrofit and renovation of boathouse
- New pier and creation of Basin 2
- New floating and training docks at Basin 2
- Shoreline enhancements between the boathouse and new pier including improvements along the existing pedestrian path to provide diverse recreational opportunities such as resting nodes with seating elements, waterfront plaza, public pier and view deck with a shade structure, fire pit, and furnishings

Phase Three of the project would add classrooms and outdoor learning spaces associated with the Marine Programs Multi-Use Building. A marine hydrokinetic (MHK) barge and linking trestle are also envisioned during this phase but may be advanced to Phase Two based on Cal Maritime's prioritization of the master plan projects. This phase would also focus on betterment of the campus-coastline experiences and open spaces and heightened level of resilience to climate and storm-related stresses. As shown on Figure 9, Phase Three components would include:

- Marine Programs Multi-Use Building
- Harbor Control Tower
- MHK Barge and Linking Trestle
- Central Waterfront Esplanade Canopy
- Row House and Floating Landing
- Shoreline Enhancements between the row house and dining center
- Waterfront overlook/outdoor room one
- Waterfront overlook/outdoor room two

Phase Two and Three components will be analyzed at a programmatic level as some project-specific details are not yet finalized.

Potential Environmental Effects: The EIR will describe the significant direct and indirect environmental impacts of the project. The EIR will also evaluate the proposed project's incremental contributions to the cumulative impacts of past, present, and probable future projects. Cal Maritime has preliminarily determined that the project could result in potentially significant environmental impacts in the following resource areas, which will be evaluated in detail in the EIR:

- **Aesthetics:** Temporary and long-term changes in visual character or views of the site from key public vantage points
- **Air Quality:** Temporary increases in air pollutant emissions associated with construction and long-term increases associated with project operations
- **Archaeological, Historical, and Tribal Cultural Resources:** Substantial adverse changes to known or unknown archaeological, historical, or tribal cultural resources
- **Biological Resources:** Potential for impacts on sensitive aquatic and terrestrial habitats, including impacts on sensitive plants and wildlife
- **Energy**: Energy consumption for construction and operation of the project
- **Geology and Soils:** Potential to exacerbate geologic hazards from project construction activities if geologic hazards are present within the project site
- **Greenhouse Gas Emissions:** Temporary increases in greenhouse gas (GHG) emissions associated with mobile-source exhaust from construction worker commute trips, truck haul trips, and equipment (e.g., excavators, graders); and long-term GHG emission increases associated with project operations, including stationary and mobile sources
- **Hazards and Hazardous Materials:** Potential risks associated with accident or upset conditions during construction or due to the potential use, storage, or transportation of hazardous materials related to project construction and operations
- **Hydrology and Water Quality:** Alteration of drainage patterns, increases in impervious surfaces and stormwater runoff, and potential impacts to water quality during construction and operation of the project
- **Land Use and Planning:** Relationship to campus planning efforts including the Cal Maritime Physical Master Plan and, in the interest of intergovernmental coordination, San Francisco Bay Conservation and Development Commission policies and any other plans and policies relevant to the project
- **Noise:** Temporary increases in noise and vibration levels during construction and long-term increases in noise from project operation
- **Public Services and Recreation:** The need for new or expanded public service facilities and potential for the construction of such facilities to result in significant impacts to the environment
- **Transportation:** Temporary and long-term increases in vehicular trips, potential traffic hazards on local roadways, and impacts to transit, pedestrian, or bicycle facilities due to construction and operations
- **Utilities and Service Systems:** Increased demand for water, wastewater service, electricity, and natural gas at the project site and the potential need to increase the capacity of existing infrastructure
- **Wildfire:** Potential for the project to exacerbate existing wildfire risks

These environmental issues and related impacts will be evaluated in detail in the EIR at the project or programmatic level. As necessary, feasible and practicable mitigation measures will be recommended to reduce any identified significant or potentially significant impacts.

Cal Maritime anticipates that the project would not result in significant environmental impacts to agriculture and forest resources, mineral resources, and population and housing, and does not propose to evaluate them in depth in the EIR. Brief discussions of these resources will be provided in the EIR with explanations as to why significant impacts are not anticipated.

Potential Permits and Approvals Required: As the lead agency pursuant to CEQA, CSU is responsible for considering the adequacy of the EIR and determining whether to approve the project. However, certain project components may be subject to permitting and/or approval by agencies other than the CSU Board of Trustees. Approvals and permits that may be required from other agencies include:

- **United States Department of Transportation Maritime Administration (MARAD):** Federal lead agency responsible for compliance with the National Environmental Policy Act (NEPA) related to federally funded project components associated with NSMV, namely proposed changes to the main pier and potentially navigational aids to assist with vessel berthing
- **United States Army Corps of Engineers:** Clean Water Act Section 404 Permit and Section 10 of the Rivers and Harbors Act Permit for impacts to waters of the United States
- **San Francisco Bay Conservation and Development Commission:** Major permit under the McAteer Petris Act for activities related to in-water work, shoreline band work, and public access
- **San Francisco Regional Water Quality Control Board:** Water Quality Certification under Section 401 of the Clean Water Act and a Waste Discharge Requirement Order under the State Porter Cologne Act
- **State Lands Commission:** Basin expansion and MHK Barge
- **US Coast Guard:** Basin expansion and MHK Barge
- **State Historic Preservation Office:** Boathouse renovations

Comment Period: Written comments on the scope and content of the Draft EIR may be submitted during the scoping period, which runs from December 1, 2022 – January 3, 2023. Cal Maritime will accept mailed or electronic comments submitted by 5:00 p.m. on January 3, 2023, to the following addresses:

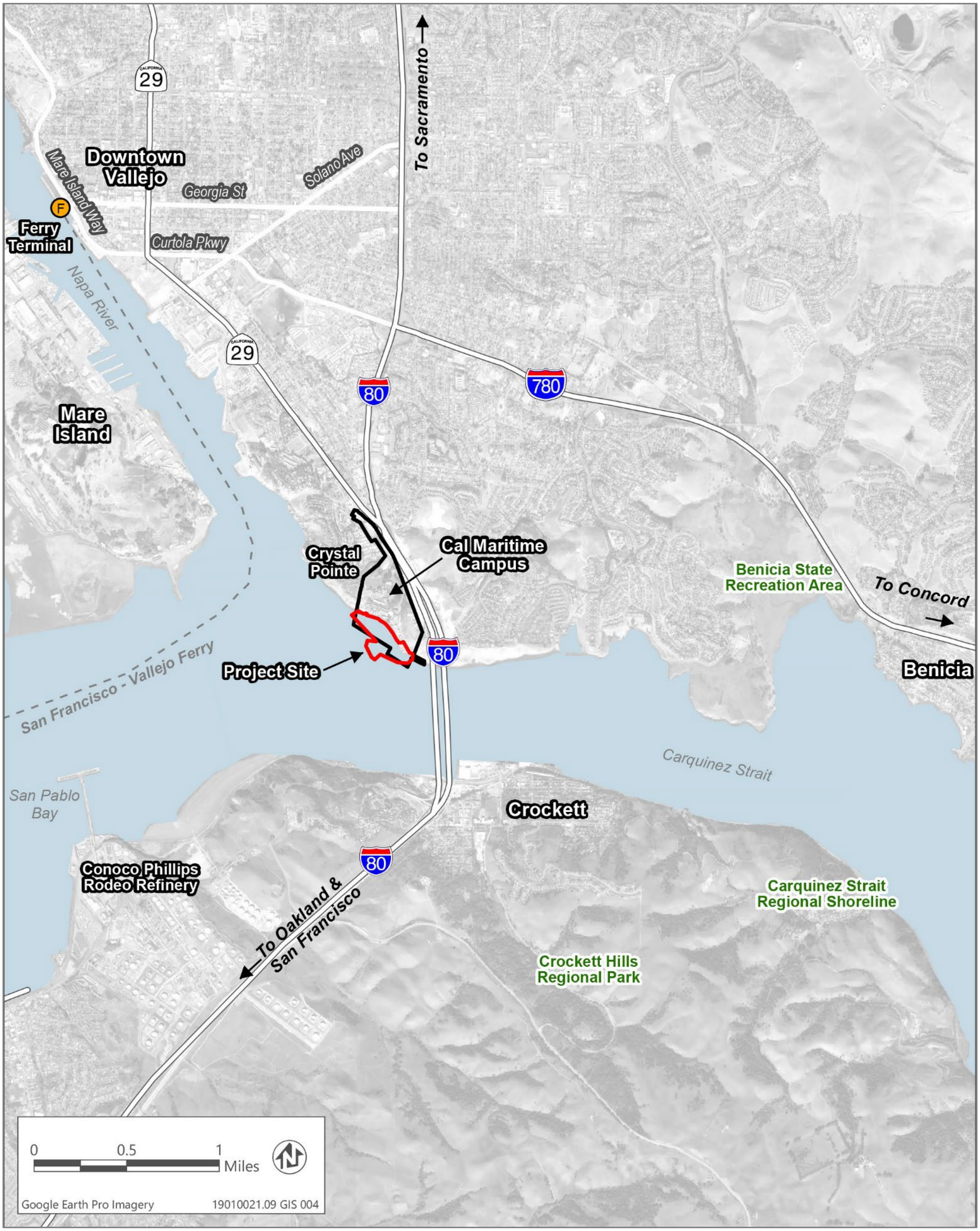
Huy Hoang
Project Manager
200 Maritime Academy Drive
Vallejo, CA 94590
Email: Huy.Hoang@cordobacorp.com

Comments provided via email should include “Cal Maritime Waterfront Master Plan NOP Scoping Comment” in the subject line and the name and physical address of the commenter in the body of the email.

Public Scoping Meeting: Cal Maritime will host a public scoping meeting on December 8, 2022, beginning at 5:00 p.m. to inform interested parties about the project, and to provide agencies and the public with an opportunity to provide comments on the scope and content of the EIR. The scoping meeting will be held as a webinar.

Participants must register to attend the scoping meeting here:
https://us06web.zoom.us/webinar/register/WN_5EBs3McHQOuTGouZks4xjQ

After registering, participants will receive a link via email to join the webinar on December 8, 2022.



Source: Adapted by Ascent Environmental in 2022

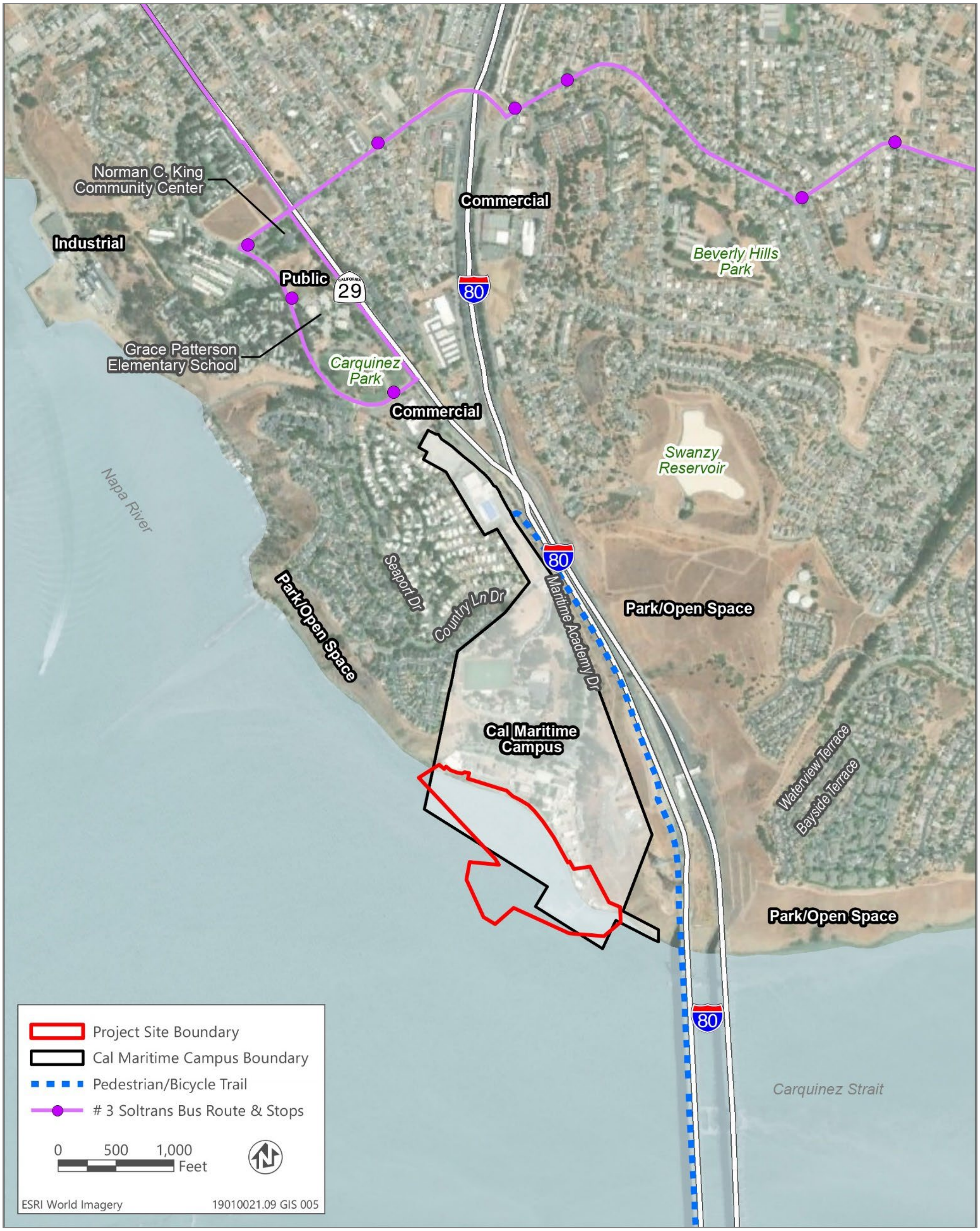
Figure 1 Regional Location

Source: Adapted by Ascent Environmental in 2022

Figure 2 Project Site

Source: Adapted by Ascent Environmental in 2022

Figure 3 Existing Uses



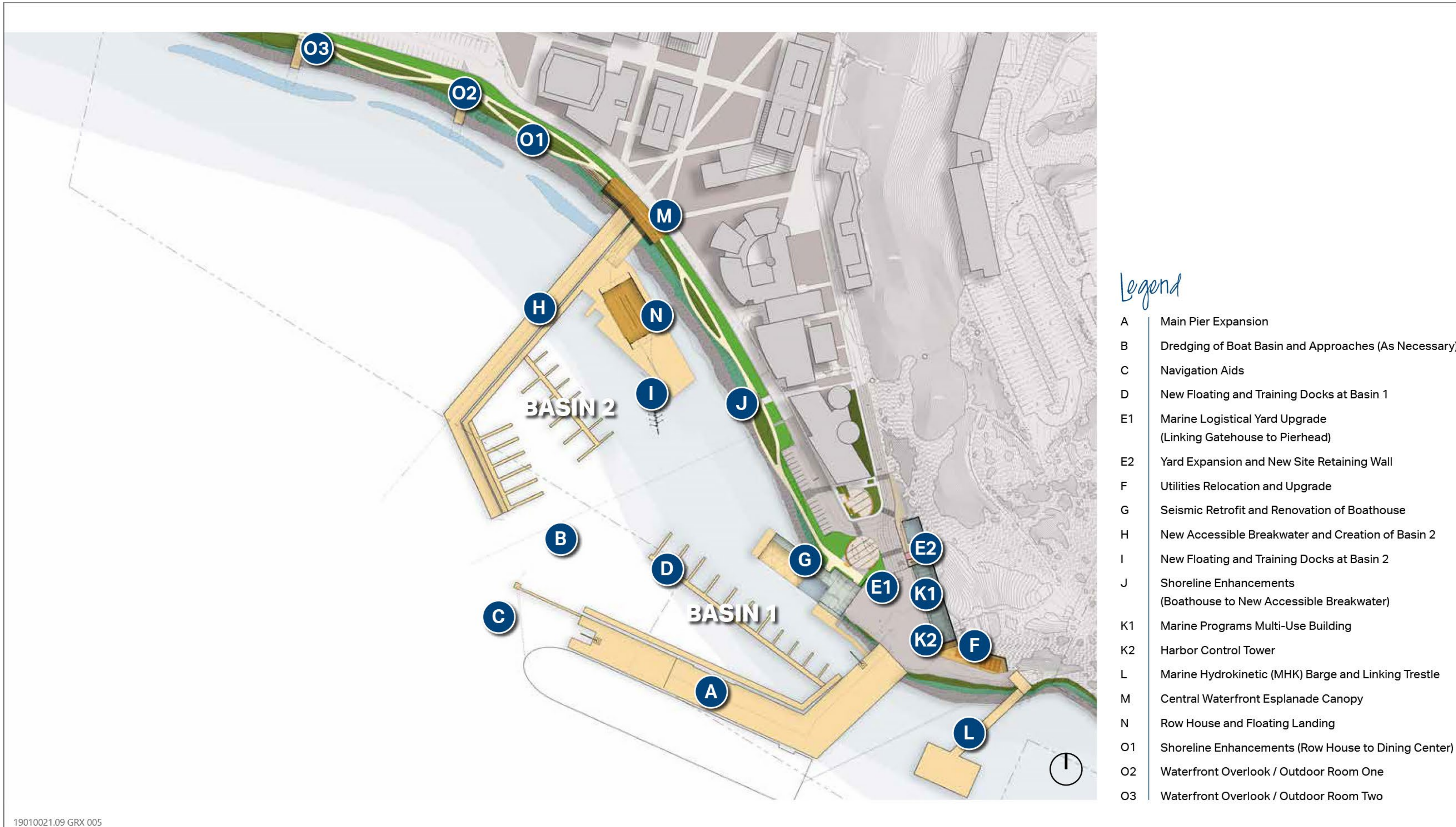
Source: Adapted by Ascent Environmental in 2022

Figure 4 Local Vicinity

19010021.09 GRX 004

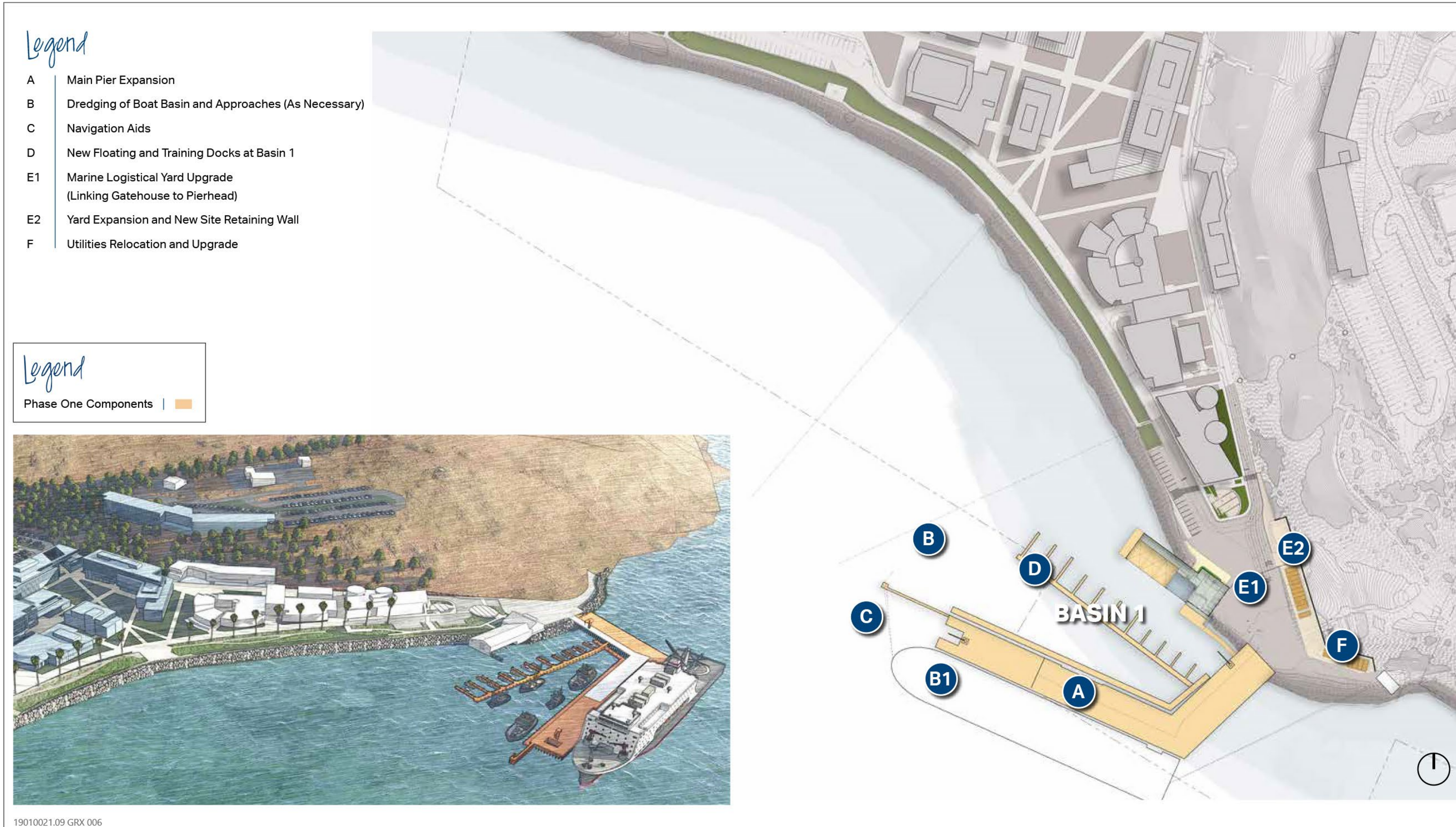
Source: Adapted by Ascent Environmental in 2022

Figure 5 Waterfront Master Plan Conceptual Rendering



Source: Adapted by Ascent Environmental in 2022

Figure 6 Waterfront Master Plan: All Components



Source: Adapted by Ascent Environmental in 2022

Figure 7 Waterfront Master Plan: Phase One Components

Source: Adapted by Ascent Environmental in 2022

Figure 8 Waterfront Master Plan: Phase Two Components

Source: Adapted by Ascent Environmental in 2022

Figure 9 Waterfront Master Plan: Phase Three Components

California Department of Transportation

DISTRICT 4
OFFICE OF REGIONAL AND COMMUNITY PLANNING
P.O. BOX 23660, MS–10D | OAKLAND, CA 94623-0660
www.dot.ca.gov

January 3, 2023

SCH #: 2022120009
GTS #: 04-SOL-2022-00262
GTS ID: 28382
Co/Rt/Pm: SOL/80/0.621

Anne Collins-Doehne, Director, Land Use Planning and Environmental Review
The Board of Trustees of the California State University
401 Golden Shore
Long Beach, CA 90802-4210

Re: California Maritime Academy Waterfront Master Plan Notice of Preparation of a Draft EIR (NOP)

Dear Anne Collins-Doehne:

Thank you for including the California Department of Transportation (Caltrans) in the environmental review process for the Waterfront Master Plan. We are committed to ensuring that impacts to the State's multimodal transportation system and to our natural environment are identified and mitigated to support a safe, sustainable, integrated and efficient transportation system. The following comments are based on our review of the December 2022 NOP.

Project Understanding
The California State University Maritime Academy proposes the preparation of a Waterfront Master Plan to develop improvements along their shoreline. The plan will have three phases to be implemented over the next 10+ years. Phase one will include expansion of the main pier, dredging new floating and training docks, expansion and upgrades to the marine yard, and utilities relocation and upgrade. Phase two would expand cadet instruction and marine programs with new breakwater, new boat basin with additional slips, renovation of the boathouse, and shoreline enhancements. Phase three will add classrooms and outdoor learning spaces.

Travel Demand Analysis
With the enactment of Senate Bill (SB) 743, Caltrans is focused on maximizing efficient development patterns, innovative travel demand reduction strategies, and multimodal improvements. For more information on how Caltrans assesses Transportation Impact Studies, please review Caltrans' Transportation Impact Study Guide (*link*).

If the project meets the screening criteria established in the City's adopted Vehicle Miles Traveled (VMT) policy to be presumed to have a less-than-significant VMT impact and exempt from detailed VMT analysis, please provide justification to support the exempt status in alignment with the City's VMT policy. Projects that do not meet the screening criteria should include a detailed VMT analysis in the DEIR, which should include the following:

- VMT analysis pursuant to the City's guidelines. Projects that result in automobile VMT per capita above the threshold of significance for existing (i.e. baseline) city-wide or regional values for similar land use types may indicate a significant impact. If necessary, mitigation for increasing VMT should be identified. Mitigation should support the use of transit and active transportation modes. Potential mitigation measures that include the requirements of other agencies such as Caltrans are fully enforceable through permit conditions, agreements, or other legally-binding instruments under the control of the City.

- A schematic illustration of walking, biking and auto conditions at the project site and study area roadways. Potential traffic safety issues to the State Transportation Network (STN) may be assessed by Caltrans via the Interim Safety Guidance (*link*).

- The project's primary and secondary effects on pedestrians, bicycles, travelers with disabilities and transit performance should be evaluated, including countermeasures and trade-offs resulting from mitigating VMT increases. Access to pedestrians, bicycle, and transit facilities must be maintained.

- Clarification of the intensity of events/receptions to be held at the location and how the associated travel demand and VMT will be mitigated.

Climate Change and Sea Level Rise

Please keep Caltrans informed about sea level rise adaptation and flood protection measures as they are developed and implemented at this project location. Caltrans is interested in engaging in multi-agency collaboration early and often, to find multi-benefit solutions that protect vulnerable shorelines, communities, infrastructure, and the environment. Please contact Caltrans Bay Area Climate Change Planning Coordinator with any questions: vishal.ream-rao@dot.ca.gov.

Utilities

Any utilities that are proposed, moved or modified within Caltrans' Right-of-Way (ROW) shall be discussed. If utilities are impacted by the project, provide site plans that show the location of existing and/or proposed utilities. These modifications require a Caltrans-issued encroachment permit.

Lead Agency
As the Lead Agency, The Board of Trustees of the California State University is responsible for all project mitigation, including any needed improvements to the STN. The project's fair share contribution, financing, scheduling, implementation responsibilities and lead agency monitoring should be fully discussed for all proposed mitigation measures.

Encroachment Permit
Please be advised that any permanent work or temporary traffic control that encroaches onto Caltrans' ROW requires a Caltrans-issued encroachment permit. As part of the encroachment permit submittal process, you may be asked by the Office of Encroachment Permits to submit a completed encroachment permit application package, digital set of plans clearly delineating Caltrans' ROW, digital copy of signed, dated and stamped (include stamp expiration date) traffic control plans, this comment letter, your response to the comment letter, and where applicable, the following items: new or amended Maintenance Agreement (MA), approved Design Standard Decision Document (DSDD), approved encroachment exception request, and/or airspace lease agreement. Your application package may be emailed to D4Permits@dot.ca.gov.

Please note that Caltrans is in the process of implementing an online, automated, and milestone-based Caltrans Encroachment Permit System (CEPS) to replace the current permit application submittal process with a fully electronic system, including online payments. The new system is expected to be available during 2023. To obtain information about the most current encroachment permit process and to download the permit application, please visit https://dot.ca.gov/programs/traffic-operations/ep/applications.

Thank you again for including Caltrans in the environmental review process. Should you have any questions regarding this letter, or for future notifications and requests for review of new projects, please email LDR-D4@dot.ca.gov.

Sincerely,

Mark Leong

MARK LEONG
District Branch Chief
Local Development Review

c: State Clearinghouse

State of California – Natural Resources Agency
DEPARTMENT OF FISH AND WILDLIFE
Bay Delta Region
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Fairfield, CA 94534
(707) 428-2002
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GAVIN NEWSOM, Governor
CHARLTON H. BONHAM, Director

December 30, 2022

Huy Hoang
Cordoba Corporation
200 Maritime Academy Drive
Vallejo, CA 94590
huy.hoang@cordobacorp.com

Subject: Waterfront Master Plan, Notice of Preparation of a Draft Environmental Impact Report, SCH No. 2022120009, Solano County

Dear Mr. Hoang:

The California Department of Fish and Wildlife (CDFW) reviewed the Notice of Preparation (NOP) of a Draft Program Environmental Impact Report (EIR) for the Waterfront Master Plan (Project).

CDFW is providing California State University Maritime Academy as the Lead Agency, with specific detail about the scope and content of the environmental information related to CDFW's area of statutory responsibility that must be included in the EIR (Cal. Code Regs., tit. 14, § 15082, subd. (b)).

CDFW ROLE

CDFW is a **Trustee Agency** with responsibility under the California Environmental Quality Act (CEQA) for commenting on projects that could impact fish, plant, and wildlife resources (Pub. Resources Code, § 21000 et seq.; Cal. Code Regs., tit. 14, § 15386). CDFW is also considered a **Responsible Agency** if a project would require discretionary approval, such as a permit pursuant to the California Endangered Species Act (CESA) or Native Plant Protection Act (NPPA), Lake and Streambed Alteration (LSA) Program, and other provisions of the Fish and Game Code that afford protection to the State's fish and wildlife trust resources. Pursuant to our authority, CDFW has the following concerns, comments, and recommendations regarding the Project.

PROJECT DESCRIPTION AND LOCATION

The Project site is located on the campus of the California State University Maritime Academy (Cal Maritime) at 200 Maritime Academy Drive, Vallejo, CA 94590 in Solano County; Latitude 38.066694°N, Longitude 122.230044°W; Assessor's Parcel Number (APN) 006-209-0030.

The approximately 22-acre Project area includes extensive new development of Cal Maritime's waterfront facilities over the course of a 10-year Project timeline, divided into three phases. Phase One is anticipated to be analyzed at the Project level, and Phase Two and Phase Three will be analyzed at the programmatic level.

Phase One of the Project will expand Cal Maritime's main pier, including widening the linking trestle. A series of slips and berthing areas will also be installed. Dredging will occur at the main pier berth pocket and at the existing boat basin. Maintenance dredging may occur approximately every five years. Landside improvements will include expansion and upgrades to the marine yard, including a new retaining wall, and upgrades and relocation of utilities.

Phase Two will include installation of a new breakwater and approximately 10,800 square feet of additional floating slips/berthing area for Cal Maritime's boat fleet and other vessels. Renovation and seismic retrofit of the existing boathouse would also occur. Shoreline enhancements would also occur, including installation of resting elements along the existing pedestrian path, a waterfront plaza, a public pier and view deck with shade structure, a fire pit, and other furnishings.

Phase Three will add classrooms and outdoor learning spaces to the existing multi-use building. This phase will also include installation of a central waterfront esplanade canopy, row house and floating landing, shoreline enhancements and two waterfront overlook/outdoor rooms. Addition of a marine hydrokinetic barge and linking trestle may occur in Phase Two or Phase Three.

The CEQA Guidelines (Cal. Code Regs., tit. 14, § 15000 et seq.) require the EIR incorporate a full project description, including reasonably foreseeable future phases of the Project, that contains sufficient information to evaluate and review the Project's environmental impact (CEQA Guidelines, §§ 15124 & 15378). Please include a complete description of the following Project components in the Project description:

- Land use changes resulting from, for example, rezoning certain areas.
- Footprints of permanent Project features and temporarily impacted areas, such as staging areas and access routes.
- Area and plans for any proposed buildings/structures, ground disturbing activities, fencing, paving, stationary machinery, landscaping, and stormwater systems.
- Operational features of the Project, including level of anticipated human presence (describe seasonal or daily peaks in activity, if relevant), artificial lighting/light reflection, noise, traffic generation, and other features.
- Construction schedule, activities, equipment, and crew sizes.

REGULATORY REQUIREMENTS

California Endangered Species Act and Native Plant Protection Act

Please be advised that a CESA Incidental Take Permit (ITP) must be obtained if the Project has the potential to result in “take” of plants or animals listed under CESA or NPPA, either during construction or over the life of the Project. Issuance of a CESA ITP is subject to CEQA documentation; the CEQA document must specify impacts, mitigation measures, and a mitigation monitoring and reporting program. If the Project will impact CESA listed species, such as those identified in **Attachment 1**, early consultation is encouraged, as significant modification to the Project and mitigation measures may be required in order to obtain a CESA ITP.

CEQA requires a Mandatory Finding of Significance if a project is likely to substantially restrict the range or reduce the population of a threatened or endangered species (Pub. Resources Code, §§ 21001, subd. (c) & 21083; CEQA Guidelines, §§ 15380, 15064, and 15065). Impacts must be avoided or mitigated to less-than-significant levels unless the CEQA Lead Agency makes and supports Findings of Overriding Consideration (FOC). The CEQA Lead Agency’s FOC does not eliminate the Project proponent’s obligation to comply with CESA.

Lake and Streambed Alteration Agreement

CDFW will require an LSA Notification, pursuant to Fish and Game Code sections 1600 et. seq. for Project activities affecting lakes or streams and associated riparian habitat. Notification is required for any activity that will substantially divert or obstruct the natural flow; change or use material from the bed, channel, or bank including associated riparian or wetland resources; or deposit or dispose of material where it may pass into a river, lake or stream. Work within ephemeral streams, washes, watercourses with a subsurface flow, and floodplains are subject to notification requirements. CDFW, as a Responsible Agency under CEQA, will consider the CEQA document for the Project. CDFW may not execute the final LSA Agreement until it has complied with CEQA as a Responsible Agency.

Nesting Birds

CDFW also has authority over actions that may disturb or destroy active nest sites or take birds. Fish and Game Code sections 3503, 3503.5, and 3513 protect birds, their eggs, and nests. Migratory birds are also protected under the federal Migratory Bird Treaty Act.

Fully Protected Species

Fully Protected species, including any listed in **Attachment 1**, may not be taken or possessed at any time except for collecting these species for necessary scientific research, relocation of the bird species for the protection of livestock, or if they are a covered species whose conservation and management is provided for in a Natural Community Conservation Plan (Fish & G. Code, §§ 3511, 4700, 5050, & 5515).

ENVIRONMENTAL SETTING

The EIR should provide sufficient information regarding the environmental setting ("baseline") to understand the Project's, and its alternative's (if applicable), potentially significant impacts on the environment (CEQA Guidelines, §§ 15125 & 15360).

CDFW recommends the CEQA document prepared for the Project provide baseline habitat assessments for special-status plant, fish and wildlife species located and potentially located within the Project area and surrounding lands, including but not limited to all rare, threatened, or endangered species (CEQA Guidelines, § 15380). The EIR should describe aquatic habitats, such as wetlands or waters of the U.S. or State, and any sensitive natural communities or riparian habitat occurring on or adjacent to the Project site (for sensitive natural communities see: https://wildlife.ca.gov/Data/VegCAMP/NaturalCommunities#sensitive%20natural%20communities), and any stream or wetland set back distances the City may require. Fully protected, threatened or endangered, candidate, and other special-status species and sensitive natural communities that are known to occur, or have the potential to occur in or near the Project site, include but are not limited to those listed in **Attachment 1**.

Habitat descriptions and the potential for species occurrence should include information from multiple sources: aerial imagery, historical and recent survey data, field reconnaissance, scientific literature and reports, U.S. Fish and Wildlife Service's (USFWS) Information, Planning, and Consultation System, and findings from "positive occurrence" databases such as the California Natural Diversity Database (CNDDB). Based on the data and information from the habitat assessment, the EIR should adequately assess which special-status species are likely to occur on or near the Project site, and whether they could be impacted by the Project.

CDFW recommends that prior to Project implementation, surveys be conducted for special-status species with potential to occur, following recommended survey protocols if available. Survey and monitoring protocols and guidelines are available at: https://www.wildlife.ca.gov/Conservation/Survey-Protocol.

Botanical surveys for special-status plant species, including those with a California Rare Plant Rank (http://www.cnps.org/cnps/rareplants/inventory/), must be conducted during the blooming period within the Project area and adjacent habitats that may be indirectly impacted by, for example, changes to hydrological conditions, and require the identification of reference populations. More than one year of surveys may be necessary based on environmental conditions. Please refer to CDFW protocols for surveying and evaluating impacts to special status plants available at: https://www.wildlife.ca.gov/Conservation/Plants.

IMPACT ANALYSIS AND MITIGATION MEASURES

The EIR should discuss all direct and indirect impacts (temporary and permanent) that may occur with implementation of the Project (CEQA Guidelines, § 15126.2). This includes evaluating and describing impacts such as:

- Land use changes that would reduce open space or agricultural land uses and increase residential or other land use involving increased development;
- Encroachments into riparian habitats, wetlands or other sensitive areas;
- Potential for impacts to special-status species;
- Loss or modification of breeding, nesting, dispersal and foraging habitat, including vegetation removal, alternation of soils and hydrology, and removal of habitat structural features (e.g., snags, roosts, vegetation overhanging banks);
- Permanent and temporary habitat disturbances associated with ground disturbance, noise, lighting, reflection, air pollution, traffic or human presence; and
- Obstruction of movement corridors, fish passage, or access to water sources and other core habitat features.

The CEQA document should also identify reasonably foreseeable future projects in the Project vicinity, disclose any cumulative impacts associated with these projects, determine the significance of each cumulative impact, and assess the significance of the Project's contribution to the impact (CEQA Guidelines, §15355). Although a project's impacts may be insignificant individually, its contributions to a cumulative impact may be considerable; a contribution to a significant cumulative impact – e.g., reduction of available habitat for a special-status species – should be considered cumulatively considerable without mitigation to minimize or avoid the impact.

Based on the comprehensive analysis of the direct, indirect, and cumulative impacts of the Project, the CEQA Guidelines direct the lead agency to consider and describe all feasible mitigation measures to avoid potentially significant impacts in the EIR, and/or mitigate significant impacts of the Project on the environment (CEQA Guidelines, §§ 15021, 15063, 15071, 15126.2, 15126.4 & 15370). This includes a discussion of impact avoidance and minimization measures for special-status species, which are recommended to be developed in early consultation with CDFW, USFWS, and the National Marine Fisheries Service. These measures can then be incorporated as enforceable Project conditions to reduce potential impacts to biological resources to less-than-significant levels.

ENVIRONMENTAL DATA

CEQA requires information developed in EIRs and negative declarations be incorporated into a database which may be used to make subsequent or supplemental environmental determinations (Pub. Resources Code, § 21003, subd. (e)). Accordingly, please report any special-status species and natural communities detected during Project surveys to CNDDB. The CNNDB online field survey form and other methods for submitting data can be found at the following link: https://wildlife.ca.gov/Data/CNDDB/Submitting-Data. The types of information reported to CNDDB can be found at the following link: https://wildlife.ca.gov/Data/CNDDB/Plantsand-Animals.

FILING FEES

CDFW anticipates the Project will have an impact on fish and/or wildlife, and assessment of filing fees is necessary (Fish & G. Code, § 711.4; Pub. Resources Code, § 21089). Fees are payable upon filing of the Notice of Determination by the Lead Agency and serve to help defray the cost of environmental review by CDFW.

If you have any questions, please contact Alicia Bird, Environmental Scientist, at (707) 980-5154 or by email at alicia.bird@wildlife.ca.gov; or Melanie Day, Senior Environmental Scientist (Supervisory), at (707) 210-4415 or by email at melanie.day@wildlife.ca.gov.

Sincerely,

DocuSigned by:
Erin Chappell
B77E9A6211EF486...

Erin Chappell
Regional Manager
Bay Delta Region

Attachment 1: Special-Status Species

ec:

State Clearinghouse # 2022120009
Anne Collins-Doehne, California State University, acollins-doehne@calstate.edu
Charles Richmond, Ascent Environmental, charlie.richmond@ascentenvironmental.com

Attachment 1: Special-Status Species

Scientific Name	Common Name	Status*
Amphibians & Reptiles		
Emys marmorata	western pond turtle	SSC
Birds		
Rallus obsoletus obsoletus	California Ridgway's rail	FE, SE
Laterallus jamaicensis coturniculus	California black rail	SE, FP
Agelaius tricolor	tricolored blackbird	SE, SSC
Buteo Swainsoni	Swainson's hawk	ST
Athene cunicularia	burrowing owl	SSC
Melospiza melodia maxillaris	Suisun song sparrow	SSC
Geothlypis trichas sinuosa	saltmarsh common yellowthroat	SSC
Melospiza melodia samuelis	San Pablo song sparrow	SSC
Circus hudsonius	northern harrier	SSC
Aquila chrysaetos	golden eagle	FP, WL
Falco peregrinus anatum	American peregrine falcon	FP
Elanus leucurus	white-tailed kite	FP
Pandion haliaetus	osprey	WL
Accipiter cooperii	Cooper's hawk	WL
Plants		
Lasthenia conjugens	Contra Costa goldfields	FE, CRPR 1B.1
Chloropyron molle ssp. *molle*	soft salty bird's-beak	FE, CRPR 1B.2

Scientific Name	Common Name	Status*
Lathyrus jepsonii var. *jepsonii*	Delta tule pea	CRPR 1B.2
Helianthella castanea	Diablo helianthella	CRPR 1B.2
Lilaeopsis masonii	Mason's lilaeopsis	CRPR 1B.1
Centromadia parryi ssp. congdonii	Congdon's tarplant	CRPR 1B.1
Senecio aphanactis	chaparral ragwort	CRPR 2B.2
Blepharizonia plumosa	big tarplant	CRPR 1B.1
Cicuta maculata var. *bolanderi*	Bolander's water-hemlock	CRPR 2B.1
Dirca occidentalis	western leatherwood	CRPR 1B.2
Symphyotrichum lentum	Suisun Marsh aster	CRPR 1B.2
Polygonum marinense	Marin knotweed	CRPR 3.1
Eryngium jepsonii	Jepson's coyote-thistle	CRPR 1B.2
Isocoma arguta	Carquinez goldenbush	CRPR 1B.1
Calochortus pulchellus	Mt. Diablo fairy-lantern	CRPR 1B.2
Fritillaria liliacea	fragrant fritillary	CRPR 1B.2
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Spirinchus thaleichthys	longfin smelt	FC, ST
Oncorhynchus tshawytscha	Central Valley spring Chinook salmon ESU	FT, ST
Acipenser medirostris pop. 1	green sturgeon - southern DPS	FT

Scientific Name	Common Name	Status*
Oncorhynchus mykiss irideus	Central California Coast winter steelhead DPS	FT
Oncorhynchus mykiss	Central Valley steelhead DPS	FT
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Bombus occidentalis	western bumble bee	SC
Speyeria callippe callippe	callippe silverspot butterfly	FE
Mammals		
Reithrodontomys raviventris	salt-marsh harvest mouse	FE, SE, FP
Sorex ornatus sinuosus	Suisun shrew	SSC

*FP = state fully protected under Fish and Game Code; FE = federally listed as endangered under the Endangered Species Act (ESA); FT = federally listed as threatened under ESA; SE = state listed as endangered under CESA; ST = state listed as threatened under CESA; FC= Federal Candidate Species, SC = State Candidate Species; WL = CDFW Watch List; SR = state listed as rare under the NPPA; BGEPA = federal Bald and Golden Eagle Protection Act; SSC = state Species of Special Concern; CRPR = California Rare Plant Rank[1]

[1] CRPR 1B plants are considered rare, threatened, or endangered in California and elsewhere. Further information on CRPR ranks is available in CDFW's *Special Vascular Plants, Bryophytes, and Lichens List* (https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=109383&inline) and on the California Native Plant Society website (https://www.cnps.org/rare-plants/cnps-rare-plant-ranks).

State of California – Natural Resources Agency
DEPARTMENT OF FISH AND WILDLIFE
Bay Delta Region
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GAVIN NEWSOM, Governor
CHARLTON H. BONHAM, Director

December 30, 2022

Huy Hoang
Cordoba Corporation
200 Maritime Academy Drive
Vallejo, CA 94590
huy.hoang@cordobacorp.com

Subject: Waterfront Master Plan, Notice of Preparation of a Draft Environmental Impact Report, SCH No. 2022120009, Solano County

Dear Mr. Hoang:

The California Department of Fish and Wildlife (CDFW) reviewed the Notice of Preparation (NOP) of a Draft Program Environmental Impact Report (EIR) for the Waterfront Master Plan (Project).

CDFW is providing California State University Maritime Academy as the Lead Agency, with specific detail about the scope and content of the environmental information related to CDFW's area of statutory responsibility that must be included in the EIR (Cal. Code Regs., tit. 14, § 15082, subd. (b)).

CDFW ROLE

CDFW is a **Trustee Agency** with responsibility under the California Environmental Quality Act (CEQA) for commenting on projects that could impact fish, plant, and wildlife resources (Pub. Resources Code, § 21000 et seq.; Cal. Code Regs., tit. 14, § 15386). CDFW is also considered a **Responsible Agency** if a project would require discretionary approval, such as a permit pursuant to the California Endangered Species Act (CESA) or Native Plant Protection Act (NPPA), Lake and Streambed Alteration (LSA) Program, and other provisions of the Fish and Game Code that afford protection to the State's fish and wildlife trust resources. Pursuant to our authority, CDFW has the following concerns, comments, and recommendations regarding the Project.

PROJECT DESCRIPTION AND LOCATION

The Project site is located on the campus of the California State University Maritime Academy (Cal Maritime) at 200 Maritime Academy Drive, Vallejo, CA 94590 in Solano County; Latitude 38.066694°N, Longitude 122.230044°W; Assessor's Parcel Number (APN) 006-209-0030.

The approximately 22-acre Project area includes extensive new development of Cal Maritime's waterfront facilities over the course of a 10-year Project timeline, divided into three phases. Phase One is anticipated to be analyzed at the Project level, and Phase Two and Phase Three will be analyzed at the programmatic level.

Phase One of the Project will expand Cal Maritime's main pier, including widening the linking trestle. A series of slips and berthing areas will also be installed. Dredging will occur at the main pier berth pocket and at the existing boat basin. Maintenance dredging may occur approximately every five years. Landside improvements will include expansion and upgrades to the marine yard, including a new retaining wall, and upgrades and relocation of utilities.

Phase Two will include installation of a new breakwater and approximately 10,800 square feet of additional floating slips/berthing area for Cal Maritime's boat fleet and other vessels. Renovation and seismic retrofit of the existing boathouse would also occur. Shoreline enhancements would also occur, including installation of resting elements along the existing pedestrian path, a waterfront plaza, a public pier and view deck with shade structure, a fire pit, and other furnishings.

Phase Three will add classrooms and outdoor learning spaces to the existing multi-use building. This phase will also include installation of a central waterfront esplanade canopy, row house and floating landing, shoreline enhancements and two waterfront overlook/outdoor rooms. Addition of a marine hydrokinetic barge and linking trestle may occur in Phase Two or Phase Three.

The CEQA Guidelines (Cal. Code Regs., tit. 14, § 15000 et seq.) require the EIR incorporate a full project description, including reasonably foreseeable future phases of the Project, that contains sufficient information to evaluate and review the Project's environmental impact (CEQA Guidelines, §§ 15124 & 15378). Please include a complete description of the following Project components in the Project description:

- Land use changes resulting from, for example, rezoning certain areas.
- Footprints of permanent Project features and temporarily impacted areas, such as staging areas and access routes.
- Area and plans for any proposed buildings/structures, ground disturbing activities, fencing, paving, stationary machinery, landscaping, and stormwater systems.
- Operational features of the Project, including level of anticipated human presence (describe seasonal or daily peaks in activity, if relevant), artificial lighting/light reflection, noise, traffic generation, and other features.
- Construction schedule, activities, equipment, and crew sizes.

REGULATORY REQUIREMENTS

California Endangered Species Act and Native Plant Protection Act

Please be advised that a CESA Incidental Take Permit (ITP) must be obtained if the Project has the potential to result in "take" of plants or animals listed under CESA or NPPA, either during construction or over the life of the Project. Issuance of a CESA ITP is subject to CEQA documentation; the CEQA document must specify impacts, mitigation measures, and a mitigation monitoring and reporting program. If the Project will impact CESA listed species, such as those identified in **Attachment 1**, early consultation is encouraged, as significant modification to the Project and mitigation measures may be required in order to obtain a CESA ITP.

CEQA requires a Mandatory Finding of Significance if a project is likely to substantially restrict the range or reduce the population of a threatened or endangered species (Pub. Resources Code, §§ 21001, subd. (c) & 21083; CEQA Guidelines, §§ 15380, 15064, and 15065). Impacts must be avoided or mitigated to less-than-significant levels unless the CEQA Lead Agency makes and supports Findings of Overriding Consideration (FOC). The CEQA Lead Agency's FOC does not eliminate the Project proponent's obligation to comply with CESA.

Lake and Streambed Alteration Agreement

CDFW will require an LSA Notification, pursuant to Fish and Game Code sections 1600 et. seq. for Project activities affecting lakes or streams and associated riparian habitat. Notification is required for any activity that will substantially divert or obstruct the natural flow; change or use material from the bed, channel, or bank including associated riparian or wetland resources; or deposit or dispose of material where it may pass into a river, lake or stream. Work within ephemeral streams, washes, watercourses with a subsurface flow, and floodplains are subject to notification requirements. CDFW, as a Responsible Agency under CEQA, will consider the CEQA document for the Project. CDFW may not execute the final LSA Agreement until it has complied with CEQA as a Responsible Agency.

Nesting Birds

CDFW also has authority over actions that may disturb or destroy active nest sites or take birds. Fish and Game Code sections 3503, 3503.5, and 3513 protect birds, their eggs, and nests. Migratory birds are also protected under the federal Migratory Bird Treaty Act.

Fully Protected Species

Fully Protected species, including any listed in **Attachment 1**, may not be taken or possessed at any time except for collecting these species for necessary scientific research, relocation of the bird species for the protection of livestock, or if they are a covered species whose conservation and management is provided for in a Natural Community Conservation Plan (Fish & G. Code, §§ 3511, 4700, 5050, & 5515).

ENVIRONMENTAL SETTING

The EIR should provide sufficient information regarding the environmental setting ("baseline") to understand the Project's, and its alternative's (if applicable), potentially significant impacts on the environment (CEQA Guidelines, §§ 15125 & 15360).

CDFW recommends the CEQA document prepared for the Project provide baseline habitat assessments for special-status plant, fish and wildlife species located and potentially located within the Project area and surrounding lands, including but not limited to all rare, threatened, or endangered species (CEQA Guidelines, § 15380). The EIR should describe aquatic habitats, such as wetlands or waters of the U.S. or State, and any sensitive natural communities or riparian habitat occurring on or adjacent to the Project site (for sensitive natural communities see: https://wildlife.ca.gov/Data/VegCAMP/NaturalCommunities#sensitive%20natural%20communities), and any stream or wetland set back distances the City may require. Fully protected, threatened or endangered, candidate, and other special-status species and sensitive natural communities that are known to occur, or have the potential to occur in or near the Project site, include but are not limited to those listed in **Attachment 1**.

Habitat descriptions and the potential for species occurrence should include information from multiple sources: aerial imagery, historical and recent survey data, field reconnaissance, scientific literature and reports, U.S. Fish and Wildlife Service's (USFWS) Information, Planning, and Consultation System, and findings from "positive occurrence" databases such as the California Natural Diversity Database (CNDDB). Based on the data and information from the habitat assessment, the EIR should adequately assess which special-status species are likely to occur on or near the Project site, and whether they could be impacted by the Project.

CDFW recommends that prior to Project implementation, surveys be conducted for special-status species with potential to occur, following recommended survey protocols if available. Survey and monitoring protocols and guidelines are available at: https://www.wildlife.ca.gov/Conservation/Survey-Protocol.

Botanical surveys for special-status plant species, including those with a California Rare Plant Rank (http://www.cnps.org/cnps/rareplants/inventory/), must be conducted during the blooming period within the Project area and adjacent habitats that may be indirectly impacted by, for example, changes to hydrological conditions, and require the identification of reference populations. More than one year of surveys may be necessary based on environmental conditions. Please refer to CDFW protocols for surveying and evaluating impacts to special status plants available at: https://www.wildlife.ca.gov/Conservation/Plants.

IMPACT ANALYSIS AND MITIGATION MEASURES

The EIR should discuss all direct and indirect impacts (temporary and permanent) that may occur with implementation of the Project (CEQA Guidelines, § 15126.2). This includes evaluating and describing impacts such as:

- Land use changes that would reduce open space or agricultural land uses and increase residential or other land use involving increased development;

- Encroachments into riparian habitats, wetlands or other sensitive areas;

- Potential for impacts to special-status species;

- Loss or modification of breeding, nesting, dispersal and foraging habitat, including vegetation removal, alternation of soils and hydrology, and removal of habitat structural features (e.g., snags, roosts, vegetation overhanging banks);

- Permanent and temporary habitat disturbances associated with ground disturbance, noise, lighting, reflection, air pollution, traffic or human presence; and

- Obstruction of movement corridors, fish passage, or access to water sources and other core habitat features.

The CEQA document should also identify reasonably foreseeable future projects in the Project vicinity, disclose any cumulative impacts associated with these projects, determine the significance of each cumulative impact, and assess the significance of the Project's contribution to the impact (CEQA Guidelines, §15355). Although a project's impacts may be insignificant individually, its contributions to a cumulative impact may be considerable; a contribution to a significant cumulative impact – e.g., reduction of available habitat for a special-status species – should be considered cumulatively considerable without mitigation to minimize or avoid the impact.

Based on the comprehensive analysis of the direct, indirect, and cumulative impacts of the Project, the CEQA Guidelines direct the lead agency to consider and describe all feasible mitigation measures to avoid potentially significant impacts in the EIR, and/or mitigate significant impacts of the Project on the environment (CEQA Guidelines, §§ 15021, 15063, 15071, 15126.2, 15126.4 & 15370). This includes a discussion of impact avoidance and minimization measures for special-status species, which are recommended to be developed in early consultation with CDFW, USFWS, and the National Marine Fisheries Service. These measures can then be incorporated as enforceable Project conditions to reduce potential impacts to biological resources to less-than-significant levels.

ENVIRONMENTAL DATA

CEQA requires information developed in EIRs and negative declarations be incorporated into a database which may be used to make subsequent or supplemental environmental determinations (Pub. Resources Code, § 21003, subd. (e)). Accordingly, please report any special-status species and natural communities detected during Project surveys to CNDDB. The CNNDB online field survey form and other methods for submitting data can be found at the following link: https://wildlife.ca.gov/Data/CNDDB/Submitting-Data. The types of information reported to CNDDB can be found at the following link: https://wildlife.ca.gov/Data/CNDDB/Plantsand-Animals.

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Erin Chappell
Regional Manager
Bay Delta Region

Attachment 1: Special-Status Species

ec:

State Clearinghouse # 2022120009
Anne Collins-Doehne, California State University, acollins-doehne@calstate.edu
Charles Richmond, Ascent Environmental, charlie.richmond@ascentenvironmental.com

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NATIVE AMERICAN HERITAGE COMMISSION

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December 1, 2022

Huy Hoang
The Trustees of the California State University
200 Maritime Academy Drive
Vallejo, CA 94590

Re: 2022120009, California State University Maritime Academy Waterfront Master Plan Project, Solano County

Dear Mr. Hoang:

The Native American Heritage Commission (NAHC) has received the Notice of Preparation (NOP), Draft Environmental Impact Report (DEIR) or Early Consultation for the project referenced above. The California Environmental Quality Act (CEQA) (Pub. Resources Code §21000 et seq.), specifically Public Resources Code §21084.1, states that a project that may cause a substantial adverse change in the significance of a historical resource, is a project that may have a significant effect on the environment. (Pub. Resources Code § 21084.1; Cal. Code Regs., tit.14, §15064.5 (b) (CEQA Guidelines §15064.5 (b)). If there is substantial evidence, in light of the whole record before a lead agency, that a project may have a significant effect on the environment, an Environmental Impact Report (EIR) shall be prepared. (Pub. Resources Code §21080 (d); Cal. Code Regs., tit. 14, § 5064 subd.(a)(1) (CEQA Guidelines §15064 (a)(1)). In order to determine whether a project will cause a substantial adverse change in the significance of a historical resource, a lead agency will need to determine whether there are historical resources within the area of potential effect (APE).

CEQA was amended significantly in 2014. Assembly Bill 52 (Gatto, Chapter 532, Statutes of 2014) (AB 52) amended CEQA to create a separate category of cultural resources, "tribal cultural resources" (Pub. Resources Code §21074) and provides that a project with an effect that may cause a substantial adverse change in the significance of a tribal cultural resource is a project that may have a significant effect on the environment. (Pub. Resources Code §21084.2). Public agencies shall, when feasible, avoid damaging effects to any tribal cultural resource. (Pub. Resources Code §21084.3 (a)). **AB 52 applies to any project for which a notice of preparation, a notice of negative declaration, or a mitigated negative declaration is filed on or after July 1, 2015.** If your project involves the adoption of or amendment to a general plan or a specific plan, or the designation or proposed designation of open space, on or after March 1, 2005, it may also be subject to Senate Bill 18 (Burton, Chapter 905, Statutes of 2004) (SB 18). **Both SB 18 and AB 52 have tribal consultation requirements**. If your project is also subject to the federal National Environmental Policy Act (42 U.S.C. § 4321 et seq.) (NEPA), the tribal consultation requirements of Section 106 of the National Historic Preservation Act of 1966 (154 U.S.C. 300101, 36 C.F.R. §800 et seq.) may also apply.

The NAHC recommends consultation with California Native American tribes that are traditionally and culturally affiliated with the geographic area of your proposed project as early as possible in order to avoid inadvertent discoveries of Native American human remains and best protect tribal cultural resources. Below is a brief summary of portions of AB 52 and SB 18 as well as the NAHC's recommendations for conducting cultural resources assessments.

Consult your legal counsel about compliance with AB 52 and SB 18 as well as compliance with any other applicable laws.

AB 52

AB 52 has added to CEQA the additional requirements listed below, along with many other requirements:

1. Fourteen Day Period to Provide Notice of Completion of an Application/Decision to Undertake a Project: Within fourteen (14) days of determining that an application for a project is complete or of a decision by a public agency to undertake a project, a lead agency shall provide formal notification to a designated contact of, or tribal representative of, traditionally and culturally affiliated California Native American tribes that have requested notice, to be accomplished by at least one written notice that includes:

a. A brief description of the project.

b. The lead agency contact information.

c. Notification that the California Native American tribe has 30 days to request consultation. (Pub. Resources Code §21080.3.1 (d)).

d. A "California Native American tribe" is defined as a Native American tribe located in California that is on the contact list maintained by the NAHC for the purposes of Chapter 905 of Statutes of 2004 (SB 18). (Pub. Resources Code §21073).

2. Begin Consultation Within 30 Days of Receiving a Tribe's Request for Consultation and Before Releasing a Negative Declaration, Mitigated Negative Declaration, or Environmental Impact Report: A lead agency shall begin the consultation process within 30 days of receiving a request for consultation from a California Native American tribe that is traditionally and culturally affiliated with the geographic area of the proposed project. (Pub. Resources Code §21080.3.1, subds. (d) and (e)) and prior to the release of a negative declaration, mitigated negative declaration or Environmental Impact Report. (Pub. Resources Code §21080.3.1(b)).

a. For purposes of AB 52, "consultation shall have the same meaning as provided in Gov. Code §65352.4 (SB 18). (Pub. Resources Code §21080.3.1 (b)).

3. Mandatory Topics of Consultation If Requested by a Tribe: The following topics of consultation, if a tribe requests to discuss them, are mandatory topics of consultation:

a. Alternatives to the project.

b. Recommended mitigation measures.

c. Significant effects. (Pub. Resources Code §21080.3.2 (a)).

4. Discretionary Topics of Consultation: The following topics are discretionary topics of consultation:

a. Type of environmental review necessary.

b. Significance of the tribal cultural resources.

c. Significance of the project's impacts on tribal cultural resources.

d. If necessary, project alternatives or appropriate measures for preservation or mitigation that the tribe may recommend to the lead agency. (Pub. Resources Code §21080.3.2 (a)).

5. Confidentiality of Information Submitted by a Tribe During the Environmental Review Process: With some exceptions, any information, including but not limited to, the location, description, and use of tribal cultural resources submitted by a California Native American tribe during the environmental review process shall not be included in the environmental document or otherwise disclosed by the lead agency or any other public agency to the public, consistent with Government Code §6254 (r) and §6254.10. Any information submitted by a California Native American tribe during the consultation or environmental review process shall be published in a confidential appendix to the environmental document unless the tribe that provided the information consents, in writing, to the disclosure of some or all of the information to the public. (Pub. Resources Code §21082.3 (c)(1)).

6. Discussion of Impacts to Tribal Cultural Resources in the Environmental Document: If a project may have a significant impact on a tribal cultural resource, the lead agency's environmental document shall discuss both of the following:

a. Whether the proposed project has a significant impact on an identified tribal cultural resource.

b. Whether feasible alternatives or mitigation measures, including those measures that may be agreed to pursuant to Public Resources Code §21082.3, subdivision (a), avoid or substantially lessen the impact on the identified tribal cultural resource. (Pub. Resources Code §21082.3 (b)).

7. Conclusion of Consultation: Consultation with a tribe shall be considered concluded when either of the following occurs:

- **a.** The parties agree to measures to mitigate or avoid a significant effect, if a significant effect exists, on a tribal cultural resource; or
- **b.** A party, acting in good faith and after reasonable effort, concludes that mutual agreement cannot be reached. (Pub. Resources Code §21080.3.2 (b)).

8. Recommending Mitigation Measures Agreed Upon in Consultation in the Environmental Document: Any mitigation measures agreed upon in the consultation conducted pursuant to Public Resources Code §21080.3.2 shall be recommended for inclusion in the environmental document and in an adopted mitigation monitoring and reporting program, if determined to avoid or lessen the impact pursuant to Public Resources Code §21082.3, subdivision (b), paragraph 2, and shall be fully enforceable. (Pub. Resources Code §21082.3 (a)).

9. Required Consideration of Feasible Mitigation: If mitigation measures recommended by the staff of the lead agency as a result of the consultation process are not included in the environmental document or if there are no agreed upon mitigation measures at the conclusion of consultation, or if consultation does not occur, and if substantial evidence demonstrates that a project will cause a significant effect to a tribal cultural resource, the lead agency shall consider feasible mitigation pursuant to Public Resources Code §21084.3 (b). (Pub. Resources Code §21082.3 (e)).

10. Examples of Mitigation Measures That, If Feasible, May Be Considered to Avoid or Minimize Significant Adverse Impacts to Tribal Cultural Resources:

- **a.** Avoidance and preservation of the resources in place, including, but not limited to:
  - **i.** Planning and construction to avoid the resources and protect the cultural and natural context.
  - **ii.** Planning greenspace, parks, or other open space, to incorporate the resources with culturally appropriate protection and management criteria.
- **b.** Treating the resource with culturally appropriate dignity, taking into account the tribal cultural values and meaning of the resource, including, but not limited to, the following:
  - **i.** Protecting the cultural character and integrity of the resource.
  - **ii.** Protecting the traditional use of the resource.
  - **iii.** Protecting the confidentiality of the resource.
- **c.** Permanent conservation easements or other interests in real property, with culturally appropriate management criteria for the purposes of preserving or utilizing the resources or places.
- **d.** Protecting the resource. (Pub. Resource Code §21084.3 (b)).
- **e.** Please note that a federally recognized California Native American tribe or a non-federally recognized California Native American tribe that is on the contact list maintained by the NAHC to protect a California prehistoric, archaeological, cultural, spiritual, or ceremonial place may acquire and hold conservation easements if the conservation easement is voluntarily conveyed. (Civ. Code §815.3 (c)).
- **f.** Please note that it is the policy of the state that Native American remains and associated grave artifacts shall be repatriated. (Pub. Resources Code §5097.991).

11. Prerequisites for Certifying an Environmental Impact Report or Adopting a Mitigated Negative Declaration or Negative Declaration with a Significant Impact on an Identified Tribal Cultural Resource: An Environmental Impact Report may not be certified, nor may a mitigated negative declaration or a negative declaration be adopted unless one of the following occurs:

- **a.** The consultation process between the tribes and the lead agency has occurred as provided in Public Resources Code §21080.3.1 and §21080.3.2 and concluded pursuant to Public Resources Code §21080.3.2.
- **b.** The tribe that requested consultation failed to provide comments to the lead agency or otherwise failed to engage in the consultation process.
- **c.** The lead agency provided notice of the project to the tribe in compliance with Public Resources Code §21080.3.1 (d) and the tribe failed to request consultation within 30 days. (Pub. Resources Code §21082.3 (d)).

The NAHC's PowerPoint presentation titled, "Tribal Consultation Under AB 52: Requirements and Best Practices" may be found online at: http://nahc.ca.gov/wp-content/uploads/2015/10/AB52TribalConsultation_CalEPAPDF.pdf

SB 18

SB 18 applies to local governments and requires local governments to contact, provide notice to, refer plans to, and consult with tribes prior to the adoption or amendment of a general plan or a specific plan, or the designation of open space. (Gov. Code §65352.3). Local governments should consult the Governor's Office of Planning and Research's "Tribal Consultation Guidelines," which can be found online at: https://www.opr.ca.gov/docs/09_14_05_Updated_Guidelines_922.pdf.

Some of SB 18's provisions include:

1. Tribal Consultation: If a local government considers a proposal to adopt or amend a general plan or a specific plan, or to designate open space it is required to contact the appropriate tribes identified by the NAHC by requesting a "Tribal Consultation List." If a tribe, once contacted, requests consultation the local government must consult with the tribe on the plan proposal. **A tribe has 90 days from the date of receipt of notification to request consultation unless a shorter timeframe has been agreed to by the tribe.** (Gov. Code §65352.3 (a)(2)).
2. No Statutory Time Limit on SB 18 Tribal Consultation. There is no statutory time limit on SB 18 tribal consultation.
3. Confidentiality: Consistent with the guidelines developed and adopted by the Office of Planning and Research pursuant to Gov. Code §65040.2, the city or county shall protect the confidentiality of the information concerning the specific identity, location, character, and use of places, features and objects described in Public Resources Code §5097.9 and §5097.993 that are within the city's or county's jurisdiction. (Gov. Code §65352.3 (b)).
4. Conclusion of SB 18 Tribal Consultation: Consultation should be concluded at the point in which:
    a. The parties to the consultation come to a mutual agreement concerning the appropriate measures for preservation or mitigation; or
    b. Either the local government or the tribe, acting in good faith and after reasonable effort, concludes that mutual agreement cannot be reached concerning the appropriate measures of preservation or mitigation. (Tribal Consultation Guidelines, Governor's Office of Planning and Research (2005) at p. 18).

Agencies should be aware that neither AB 52 nor SB 18 precludes agencies from initiating tribal consultation with tribes that are traditionally and culturally affiliated with their jurisdictions before the timeframes provided in AB 52 and SB 18. For that reason, we urge you to continue to request Native American Tribal Contact Lists and "Sacred Lands File" searches from the NAHC. The request forms can be found online at: http://nahc.ca.gov/resources/forms/.

NAHC Recommendations for Cultural Resources Assessments

To adequately assess the existence and significance of tribal cultural resources and plan for avoidance, preservation in place, or barring both, mitigation of project-related impacts to tribal cultural resources, the NAHC recommends the following actions:

1. Contact the appropriate regional California Historical Research Information System (CHRIS) Center (https://ohp.parks.ca.gov/?page_id=30331) for an archaeological records search. The records search will determine:
    a. If part or all of the APE has been previously surveyed for cultural resources.
    b. If any known cultural resources have already been recorded on or adjacent to the APE.
    c. If the probability is low, moderate, or high that cultural resources are located in the APE.
    d. If a survey is required to determine whether previously unrecorded cultural resources are present.

2. If an archaeological inventory survey is required, the final stage is the preparation of a professional report detailing the findings and recommendations of the records search and field survey.
    a. The final report containing site forms, site significance, and mitigation measures should be submitted immediately to the planning department. All information regarding site locations, Native American human remains, and associated funerary objects should be in a separate confidential addendum and not be made available for public disclosure.
    b. The final written report should be submitted within 3 months after work has been completed to the appropriate regional CHRIS center.

3. Contact the NAHC for:

a. A Sacred Lands File search. Remember that tribes do not always record their sacred sites in the Sacred Lands File, nor are they required to do so. A Sacred Lands File search is not a substitute for consultation with tribes that are traditionally and culturally affiliated with the geographic area of the project's APE.

b. A Native American Tribal Consultation List of appropriate tribes for consultation concerning the project site and to assist in planning for avoidance, preservation in place, or, failing both, mitigation measures.

4. Remember that the lack of surface evidence of archaeological resources (including tribal cultural resources) does not preclude their subsurface existence.

a. Lead agencies should include in their mitigation and monitoring reporting program plan provisions for the identification and evaluation of inadvertently discovered archaeological resources per Cal. Code Regs., tit. 14, §15064.5(f) (CEQA Guidelines §15064.5(f)). In areas of identified archaeological sensitivity, a certified archaeologist and a culturally affiliated Native American with knowledge of cultural resources should monitor all ground-disturbing activities.

b. Lead agencies should include in their mitigation and monitoring reporting program plans provisions for the disposition of recovered cultural items that are not burial associated in consultation with culturally affiliated Native Americans.

c. Lead agencies should include in their mitigation and monitoring reporting program plans provisions for the treatment and disposition of inadvertently discovered Native American human remains. Health and Safety Code §7050.5, Public Resources Code §5097.98, and Cal. Code Regs., tit. 14, §15064.5, subdivisions (d) and (e) (CEQA Guidelines §15064.5, subds. (d) and (e)) address the processes to be followed in the event of an inadvertent discovery of any Native American human remains and associated grave goods in a location other than a dedicated cemetery.

If you have any questions or need additional information, please contact me at my email address: Pricilla.Torres-Fuentes@nahc.ca.gov.

Sincerely,

Pricilla Torres-Fuentes

Pricilla Torres-Fuentes
Cultural Resources Analyst

cc: State Clearinghouse

BIRDING — EDUCATION — CITIZEN SCIENCE — HABITAT CONSERVATION

Dec 26, 2022

Hug Hoag, Project Manger
200 Maritime Academy Drive
Vallejo, CA 94590
Subj: Cal Maritime Waterfront Master Plan NOP Scoping Comment

Dear Huy Hoang,

I am writing today in behalf of the 904 members of the Napa-Solano Audubon Society (NSAS) as a member of its Conservation Committee on the Notice Of Preparation (NOP) of Environmental Impact Report (EIR) on the Waterfront Master Plan California State University Maritime Academy.

Sorry that we missed the Public Scoping Meeting on Dec 8, as this document was sent to the late Gerald Karr's address, former President of the NSAS, and forwarded after his wife got this to NSAS.

NSAS feels that this proposal will serve the people of the State of California and improve the facilities of those that attend the California State University Maritime Academy.

Draft EIR should discuss public access to the piers because the waters over where the piers are over belong to the people of the State of California. NSAS is especially interested in the California State University Maritime Academy providing access and observation areas on the proposed piers for Basin 2, and the one Basin 1. Why? During the winter the current bay where the Training Ship Golden Bear (TSGB) is docked provides one of the best places in Solano County to view unusual waterfowl. Currently, we try to see them from the heights above the Maritime Academy. If there are places on the propose piers, bird watchers can see them closer to make better identification of the rare ones that come in from a coastal storm. Could you also discuss the ability of California State University Maritime Academy to issue free parking passes to do this activity.

Thank you for allowing NSAS to make comments on what the Draft EIR should mention.

Sincerely,

Robin L.C. Leong

Robin L.C. Leong
Member of the NSAS conservation committee
e-mail: robin_leong@sonic.net

CALIFORNIA STATE LANDS COMMISSION
100 Howe Avenue, Suite 100-South
Sacramento, CA 95825-8202

JENNIFER LUCCHESI, *Executive Officer*
(916) 574-1800
TTY CA Relay Service: **711** *or Phone* **800.735.2922**
from Voice Phone **800.735.2929**
or for Spanish **800.855.3000**

Established in 1938

Contact Phone: **(916) 574-1890**

December 30, 2022

File Ref: SCH # 2022120009

California State University
Attn: Huy Hoang
200 Maritime Academy Drive
Vallejo, CA 94590

*VIA REGULAR & ELECTRONIC MAIL (*Huy.Hoang@cordobacorp.com)

Subject: Notice of Preparation for a Draft Environmental Impact Report for Cal Maritime Waterfront Master Plan, Solano County

Dear Huy Hoang:

The California State Lands Commission (Commission) staff has reviewed the subject Notice of Preparation (NOP) for a Draft Environmental Impact Report (Draft EIR) for the Cal Maritime Waterfront Master Plan (Project), which is being prepared by the California State University Board of Trustees (CSU Board). The CSU Board, as the public agency proposing to carry out the Project, is the lead agency under the California Environmental Quality Act (CEQA) (Pub. Resources Code, § 21000 et seq). The Commission is a trustee agency for projects that could directly or indirectly affect State sovereign lands and their accompanying Public Trust resources or uses. Additionally, because the Project involves work on State sovereign land, the Commission will act as a responsible agency. Commission staff requests that the CSU Board consult with us on preparation of the Draft EIR as required by CEQA section 21153, subdivision (a) and the State CEQA Guidelines (California Code of Regulations, title 14) section 15086, subdivisions (a)(1) and (a)(2).

Commission Jurisdiction and Public Trust Lands

The Commission has jurisdiction and management authority over all ungranted tidelands, submerged lands, and the beds of navigable lakes and waterways.

The Commission also has certain residual and review authority for tidelands and submerged lands legislatively granted in trust to local jurisdictions (Pub. Resources Code, §§ 6009, subd. (c); 6009.1; 6301; 6306). All tidelands and submerged lands, granted or ungranted, as well as navigable lakes and waterways, are subject to the protections of the common law Public Trust Doctrine.

As general background, the State of California acquired sovereign ownership of all tidelands and submerged lands and beds of navigable lakes and waterways upon its admission to the United States in 1850. The State holds these lands for the benefit of all people of the state for statewide Public Trust purposes, which include but are not limited to waterborne commerce, navigation, fisheries, water-related recreation, habitat preservation, and open space. On tidal waterways, the State's sovereign fee ownership extends landward to the mean high tide line, except for areas of fill or artificial accretion or where the boundary has been fixed by agreement or a court. Such boundaries may not be readily apparent from present day site inspections.

Per the Commission's records, there is an existing lease (Lease 4345) at the Project location. Therefore, work within the Carquinez Strait below the mean high tide line as noted in the NOP would encroach on lands managed by the State of California and require a lease. The CSU Board should provide preliminary plans showing the most recently surveyed mean high tide line for further review once they are available to Kenneth Foster (contact information is provided at the end of this letter).

<u>Project Description</u>

The CSU Board is preparing the Cal Maritime Waterfront Master Plan to redevelop Cal Maritime's in-water and landside facilities and infrastructure to support academic and port operations, public access, environmental factors, and long-term resiliency.

From the Project Description, Commission staff understands that all in-water Project activities have potential to affect State sovereign land in Phases One, Two, and Three.

<u>Environmental Review</u>

Commission staff requests that the CSU Board consider the following comments when preparing the Draft EIR, to ensure that impacts to State sovereign land are adequately analyzed for the Commission's use of the EIR to support a future lease approval for the Project. Commission staff understands that Phase 1 activities will be analyzed at a project level, which Commission staff will rely on for issuance of a lease within Commission jurisdiction. Phases 2 and 3 will have programmatic analysis as discussed below.

General Comments

1. Programmatic Document: Because Phases Two and Three are being proposed at a programmatic rather than a project level, the Commission expects those phases will be presented as a series of distinct but related sequential activities (i.e., new pier and docks, the creation of Basin 2, floating landing). The State CEQA Guidelines, section 15168, subdivision (c)(5) states that a program EIR will be most helpful in dealing with subsequent activities if it deals with the effects of the program as specifically and comprehensively as possible. In order to avoid the improper deferral of mitigation, a common flaw in program-level analysis, mitigation measures (MMs) should either be presented as specific, feasible, enforceable obligations, or should be presented as formulas containing "performance standards which would mitigate the significant effect of the project, and which may be accomplished in more than one specified way" (State CEQA Guidelines, § 15126.4, subd. (a)). As such, the programmatic portion of the EIR should make an effort to distinguish what activities and associated mitigation measures are being analyzed in sufficient detail to be covered under the EIR without additional project-specific environmental review, and what activities will trigger the need for additional environmental analysis (see State CEQA Guidelines, § 15168, subd. (c)).

2. Project Description: A thorough and complete Project Description should be included in the EIR to facilitate meaningful environmental review of potential impacts, mitigation measures, and alternatives. The Project Description should be as precise as possible in describing the details of all allowable activities (e.g., types of equipment or methods that may be used, maximum area of impact or volume of sediment removed or disturbed, seasonal work windows, locations for material disposal, etc.), as well as the details of the timing and length of activities. In particular, please illustrate on figures and engineering plans and provide written description of activities occurring below the mean high tide line. Thorough descriptions will facilitate Commission staff's determination of the extent and locations of its leasing jurisdiction, make for a more robust analysis of the work that may be performed, and minimize the potential for subsequent environmental analysis to be required.

Biological Resources

3. For land under the Commission's jurisdiction, the Draft EIR should disclose and analyze all potentially significant effects on sensitive species and habitats in and around the Project area, including special-status wildlife, fish, and plants, and if appropriate, identify feasible mitigation measures to reduce those impacts. The CSU Board should conduct queries of the California Department of Fish and Wildlife's (CDFW) California Natural Diversity Database and U.S. Fish and Wildlife Service's (USFWS) Special Status Species Database to identify any special-status plant or wildlife species that may occur in the Project area. The Draft EIR should also include a discussion of consultation with the CDFW, USFWS, and National Marine Fisheries Service (NMFS) as applicable, including any recommended mitigation measures and potentially required permits identified by these agencies.

4. Invasive Species: One of the major stressors in California waterways is introduced species. Therefore, the Draft EIR should consider the Project's potential to encourage the establishment or proliferation of aquatic invasive species (AIS), including aquatic and terrestrial plants. For example, construction boats and barges brought in from long stays at distant projects may transport new species to the Project area via vessel biofouling, wherein marine and aquatic organisms attach to and accumulate on the hull and other submerged parts of a vessel. If the analysis in the Draft EIR finds potentially significant AIS impacts, possible mitigation could include contracting vessels and barges from nearby or requiring contractors to perform vessel cleaning prior to arrival. The CDFW's Invasive Species Program and Commission Marine Invasive Species Program could assist with this analysis as well as with the development of appropriate mitigation (information at https://www.wildlife.ca.gov/Conservation/Invasives and https://www.slc.ca.gov/misp/).

   In addition, in light of the recent decline of native pelagic organisms and in order to protect at-risk fish species, the Draft EIR should examine if any elements of the Project would favor non-native fisheries.

5. Construction Noise: The Draft EIR should also evaluate noise and vibration impacts on fish and birds from construction, restoration, or flood control activities in the water, on the levees, and for landside supporting structures. Mitigation measures could include species-specific work windows as defined by CDFW, USFWS, and NMFS. Again, staff recommends early consultation with these agencies to minimize the impacts of the Project on sensitive species.

Climate Change

6. Sea Level Rise: A tremendous amount of State-owned lands and resources under the Commission's jurisdiction will be impacted by rising sea levels. With this in mind, the Draft EIR should consider discussing if and how various Project components might be affected by sea level rise and whether "resilient" designs have been incorporated. The Carquinez Strait and its surroundings will be affected by rising sea levels. Additionally, because of their nature and location, these lands and resources are already vulnerable to a range of natural events, such as storms and extreme high tides. As the Project phases are designed and evaluated, attention should be given to sea level rise projections to ensure the structures' designs are sufficient to ensure function, safety, and protection of the environment over the expected life of the structure.

   Governor Brown issued Executive Order B-30-15 in April 2015, which directs State government to fully implement the Safeguarding Plan and factor in climate change preparedness in planning and decision making. Please note that when considering lease applications, Commission staff will: (1) request information from applicants concerning the potential effects of sea level rise on their proposed projects; (2) if applicable, require applicants to indicate how they plan to address sea level rise and what adaptation strategies are planned during the projected life of their projects; and (3) where appropriate, recommend project modifications that would eliminate or reduce potentially adverse impacts from sea level rise, including adverse impacts on public access. In addition, the State of California released the 2018 Update to the Safeguarding California Plan to provide policy guidance for state decision-makers as part of continuing efforts to prepare for climate risks. The Safeguarding Plan sets forth "actions needed" to safeguard ocean and coastal ecosystems and resources as part of its policy recommendations for state decision-makers.

Cultural Resources

7. Submerged Resources: The Draft EIR should evaluate potential impacts to submerged cultural resources in the Project area. The Commission maintains a shipwrecks database that can assist with this analysis. Commission staff requests that the CSU Board contact Staff Attorney Jamie Garrett (see contact information below) to obtain shipwrecks data from the database and Commission records for the Project site. The database includes known and potential vessels located on the State's tide and submerged lands; however, the locations of many shipwrecks remain unknown. Please note that any submerged archaeological site or submerged historic resource that has remained in state waters for more than 50 years is presumed to be

significant. Because of this possibility, please add a mitigation measure requiring that in the event cultural resources are discovered during any construction activities, Project personnel shall halt all activities in the immediate area and notify a qualified archaeologist to determine the appropriate course of action.

8. Title to Resources: The Draft EIR should also mention that the title to all abandoned shipwrecks, archaeological sites, and historic or cultural resources on or in the tide and submerged lands of California is vested in the State and under the jurisdiction of the California State Lands Commission (Pub. Resources Code, § 6313). Commission staff requests that the CSU Board consult with Staff Attorney Jamie Garrett, should any cultural resources on State lands be discovered during construction of the proposed Project. In addition, Commission staff requests that the following statement be included in the EIR's Mitigation and Monitoring Plan: "The final disposition of archaeological, historical, and paleontological resources recovered on State lands under the jurisdiction of the California State Lands Commission must be approved by the Commission."

Mitigation and Alternatives

9. Deferred Mitigation: In order to avoid the improper deferral of mitigation, MMs must be specific, feasible, and fully enforceable to minimize significant adverse impacts from a project, and "shall not be deferred until some future time." (State CEQA Guidelines, §15126.4, subd. (a)). For example, references to the preparation of a plan to reduce an impact, without calling out performance criteria, is considered deferral. Commission staff requests that more specific information be provided in such MMs to demonstrate how the MM is going to mitigate potential significant impacts to less than significant.

10. Alternatives: In addition to describing mitigation measures that would avoid or reduce the potentially significant impacts of the Project, the CSU Board should identify and analyze a range of reasonable alternatives to the proposed Project that would attain most of the Project objectives while avoiding or reducing one or more of the potentially significant impacts (see State CEQA Guidelines, § 15126.6). For example, construction in a biologically sensitive area may require an alternative to avoid significant impacts. The NOP does not provide any alternative examples.

Environmental Justice

11. Environmental justice is defined by California law as "the fair treatment and meaningful involvement of people of all races, cultures, and incomes with respect to the development, adoption, implementation, and enforcement of

environmental laws, regulations, and policies." (Gov. Code, § 65040.12.) This definition is consistent with the Public Trust Doctrine's principle that management of trust lands is for the benefit of all people. The Commission adopted an updated Environmental Justice Policy and Implementation Blueprint in December 2018 to ensure that environmental justice is an essential consideration in the agency's processes, decisions, and programs. The twelve goals outlined in the Policy reflect an urgent need to address the inequities of the past, so they do not continue. Through its policy, the Commission reaffirms its commitment to an informed and open process in which all people are treated equitably and with dignity, and in which its decisions are tempered by environmental justice considerations.

Although not legally required in a CEQA document, Commission staff suggests that the CSU Board include a section describing the environmental justice community outreach and engagement undertaken in developing the Draft EIR and the results of such outreach. The California Office of Environmental Health Hazard Assessment developed the CalEnviroScreen mapping tool to assist agencies with locating census tracts near proposed projects and identifying the environmental burdens, should there be any, that disproportionately impact those communities. Environmental justice communities often lack access to the decision-making process and experience barriers to becoming involved in that process. It is crucial that these communities are consulted as early as possible in the project planning process. Commission staff strongly recommends using the Community Vulnerability tool developed by BCDC, BCDC Community Vulnerability Tool and then, as applicable, reaching out through local community organizations, such as the California Environmental Justice Alliance. Engaging in early outreach will facilitate more equitable access for all community members. In this manner, the CEQA public comment process can improve and provide an opportunity for more members of the public to provide input related to environmental justice. Commission staff also recommends incorporating or addressing opportunities for community engagement in mitigation measures. Commission staff will review the environmental justice outreach and associated results as part of any future Commission action.

Thank you for the opportunity to comment on the NOP for the Draft EIR. As a trustee and responsible agency, Commission staff requests that you consult with us on this Project and keep us advised of changes to the Project Description and all other important developments. Please send additional information on the Project to the Commission staff listed below as the Draft EIR is being prepared.

Please refer questions concerning environmental review to Cynthia Herzog, Senior Environmental Scientist, at (916) 574-1310 or via email at cynthia.herzog@slc.ca.gov. For questions concerning archaeological or historic resources under Commission jurisdiction, please contact Staff Attorney Jamie Garrett, at (916) 574-0398 or via email at jamie.garrett@slc.ca.gov. For questions concerning Commission leasing jurisdiction, please contact Kenneth Foster, Public Land Manager, at (916) 574-2555 or via email at kenneth.foster@slc.ca.gov.

Sincerely,

Nicole Dobroski

Nicole Dobroski, Chief
Division of Environmental Planning
and Management

cc: Office of Planning and Research
C. Herzog, Commission
J. Garrett, Commission
K. Foster, Commission

Charlie Richmond

From: Natalie Muradian <NMuradian@vallejowastewater.org>
Sent: Monday, December 5, 2022 11:53 AM
To: Huy Hoang
Cc: Mark Tomko
Subject: Cal Maritime Waterfront Master Plan NOP Scoping Comment

Hi Huy,

We received a copy of the Notice of Preparation for the Cal Maritime Waterfront Master Plan EIR. I'm not sure if this is an appropriate comment at this point in the process, but wanted to provide this comment anyways:

1. Component "L" of the waterfront master plan (the Marine Hydrokinetic Barge and Linking Trestle) appears to be located over the top of or adjacent to the District's 42" discharge pipeline into the Carquinez Strait. Please confirm that this project will not impact the District's existing infrastructure.

Picture provided below for your reference:

Name of commenter: Natalie Muradian

Organization: Vallejo Flood and Wastewater District

Physical Address: 450 Ryder Street, Vallejo, CA 94590

Let me know if you have any questions. Thanks,

Natalie Muradian, PE
Vallejo Flood and Wastewater District
Desk: 707-558-3416
Main: 707-644-8949, ext. 1302

Appendix B

Existing Site Photos

Source: Provided by Cordoba 2023

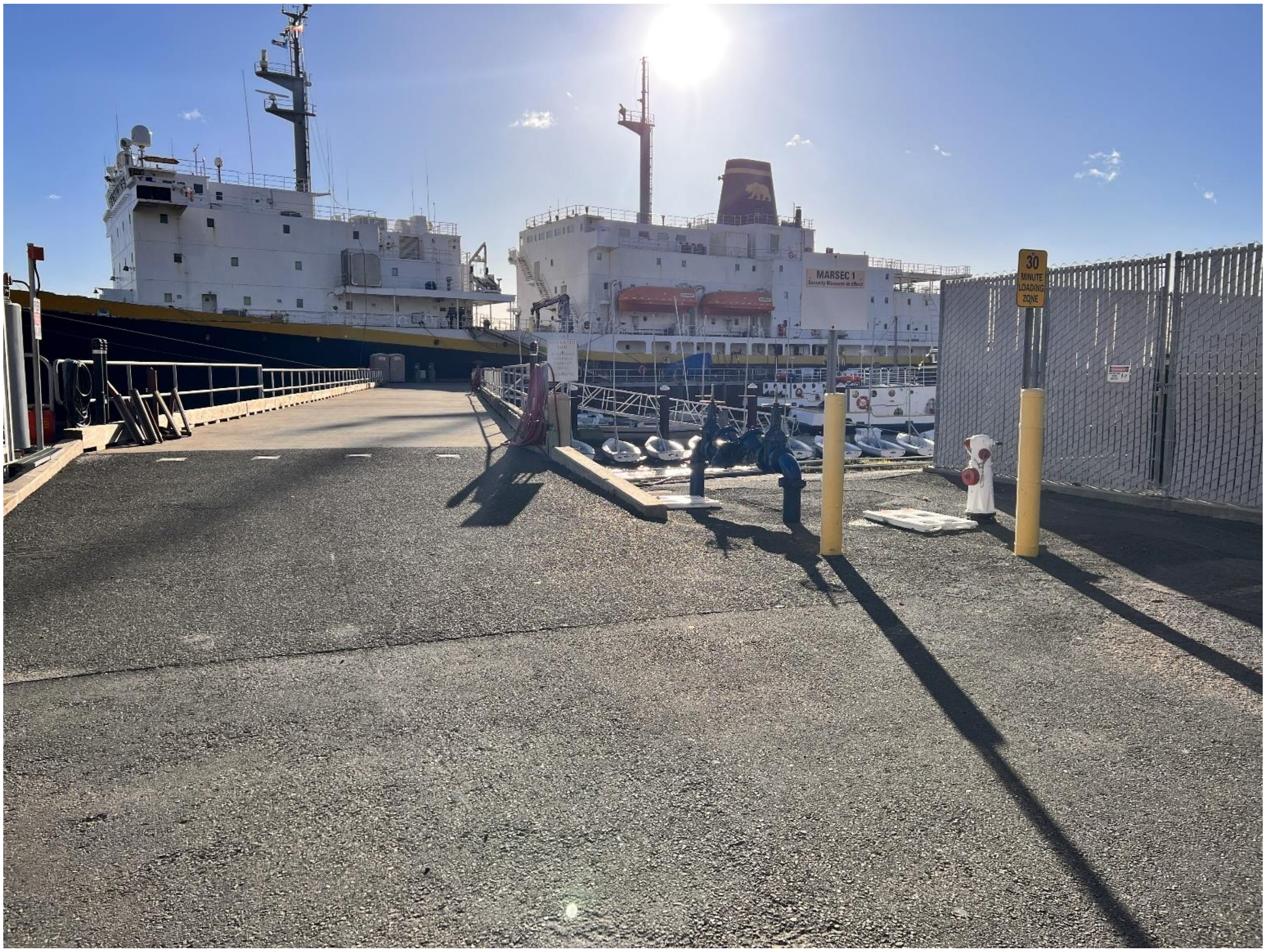
Main Pier and Training Ship Golden Bear

Source: Provided by WRA 2022

Main Pier Looking West

Source: Provided by WRA 2022

Main Pier and Training Ship Golden Bear

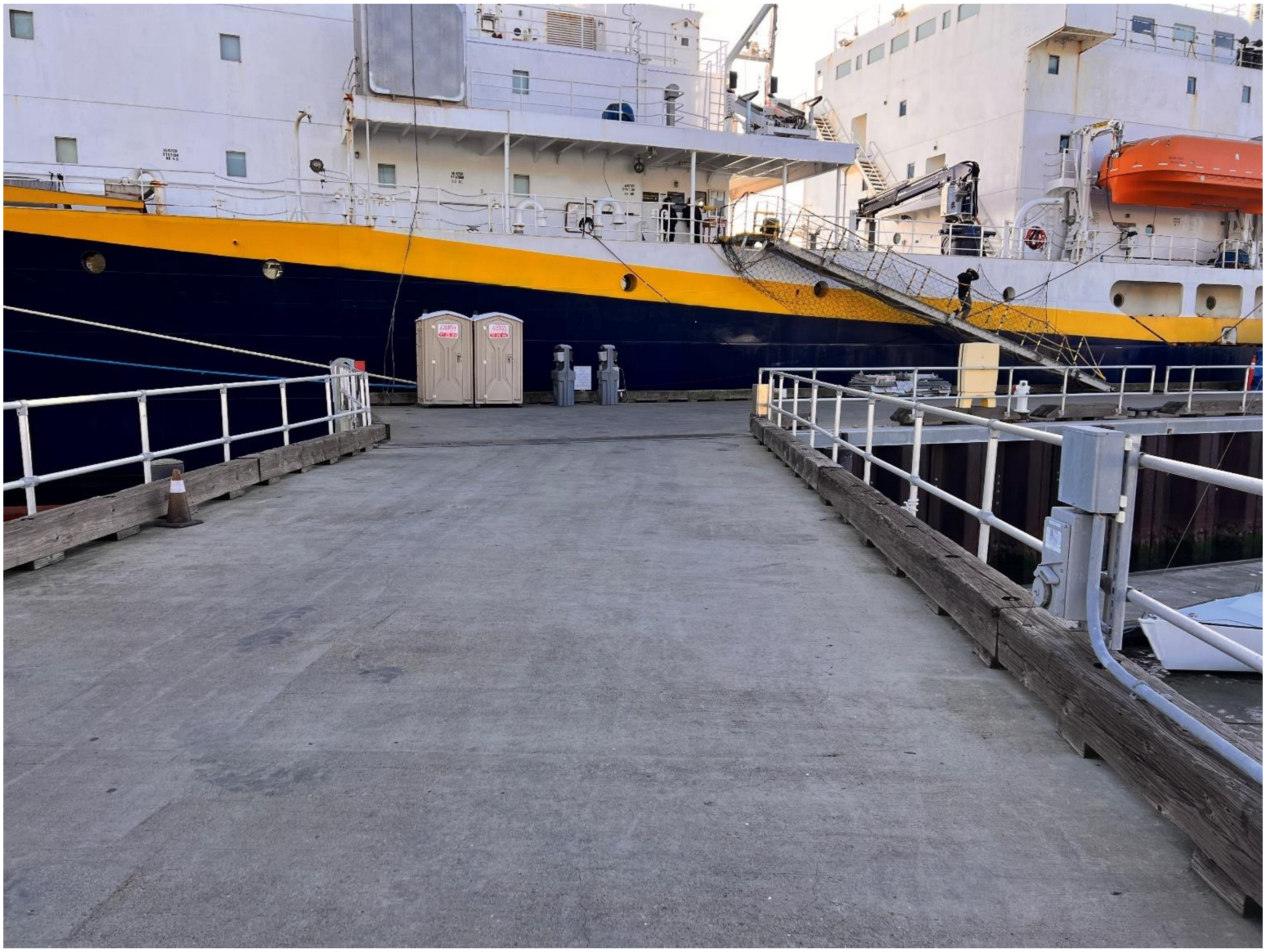


Source: Provided by Cordoba 2023

Main Pier

Source: Provided by Cordoba 2023

Main Pier



Source: Provided by Cordoba 2023

Main Pier

Source: Provided by Cordoba 2023

Main Pier

Source: Provided by WRA 2022

Main Pier and Boat Basin

Source: Provided by WRA 2022

Boat Basin

Source: Provided by Cordoba 2023

Boat Basin

Source: Provided by Cordoba 2023

Marine Yard Entrance and Security Fence

Source: Provided by Cordoba 2023

Marine Yard Security Guardhouse

Source: Provided by Cordoba 2023

Marine Yard Shoreside Boilers and Storage Lockers

Source: Provided by Cordoba 2023

Marine Yard Shoreside Boilers

Source: Provided by Cordoba 2023

Marine Yard Storage Lockers

Source: Provided by Cordoba 2023

Marine Yard Electrical Substation

Source: Provided by Cordoba 2023

Marine Yard Looking East to Carquinez Vista Point

Source: Provided by Cordoba 2023

Boat Basin Looking West

Source: Provided by Cordoba 2023

Boat Basin Looking South

Source: Provided by WRA 2022

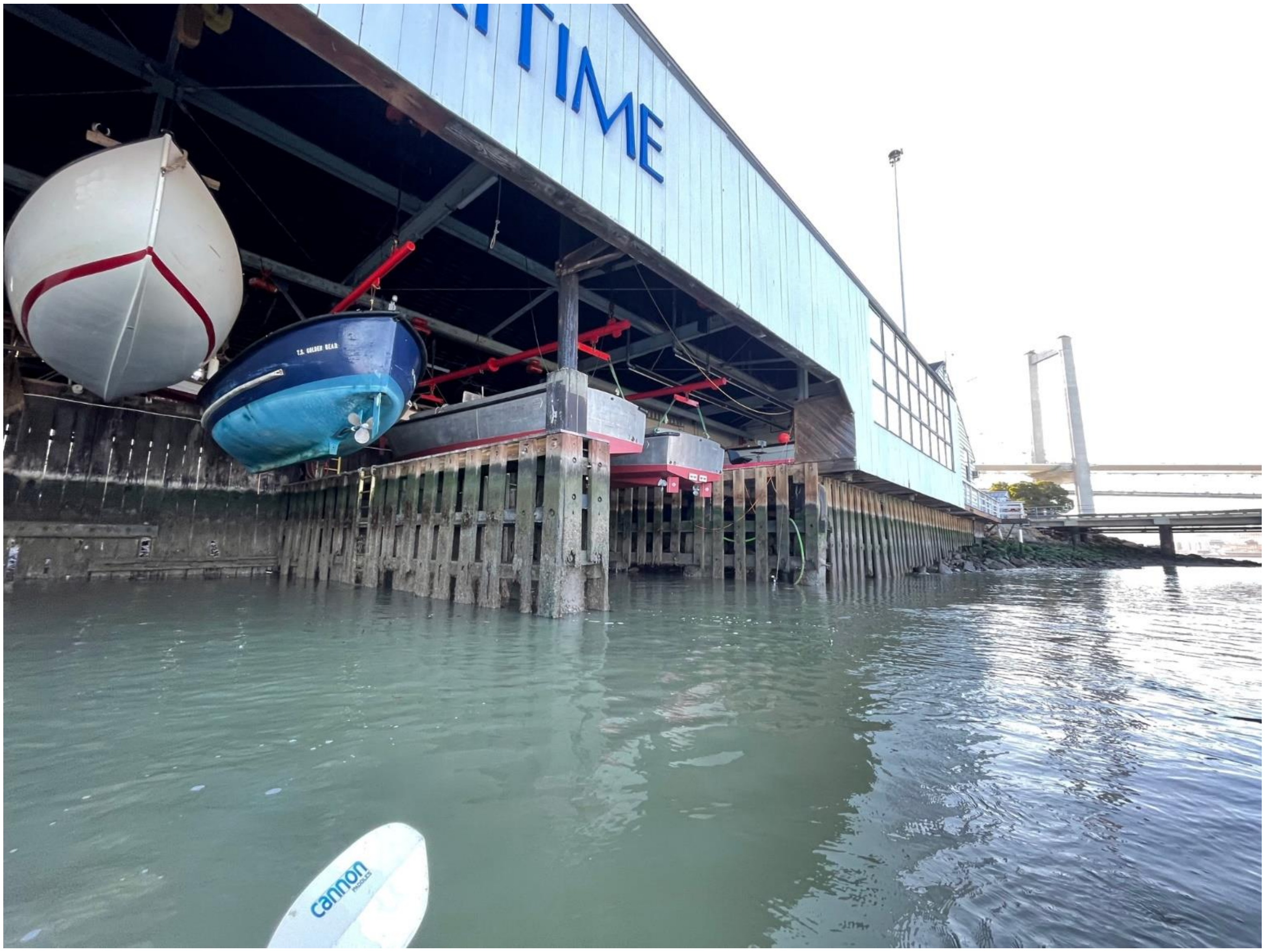
Boathouse and Boat Basin

Source: Provided by Cordoba 2023

Boathouse

Source: Page & Turnbull 2022

Boathouse Primary Entrance



Source: Provided by WRA 2022

Boathouse Transverse Wing with Boat Slips

Source: Provided by Cordoba 2023

Boathouse East Façade of Transverse Wing

Source: Page & Turnbull 2022

Boathouse South Facade

Source: Page & Turnbull 2022

Boathouse East Portion of South Facade

Source: Page & Turnbull 2022

Boathouse North Facade

Source: Page & Turnbull 2022

Boathouse West Facade

Source: Provided by Cordoba 2023

Marine Programs and Naval Sciences Building

Source: Provided by Cordoba 2023

Marine Programs and Naval Sciences Building

Source: Provided by Cordoba 2023

Entrance to Marine Programs and Naval Sciences Building

Source: Provided by WRA 2022

Shoreline Looking West Towards Mayo Hall

Source: Provided by WRA 2022

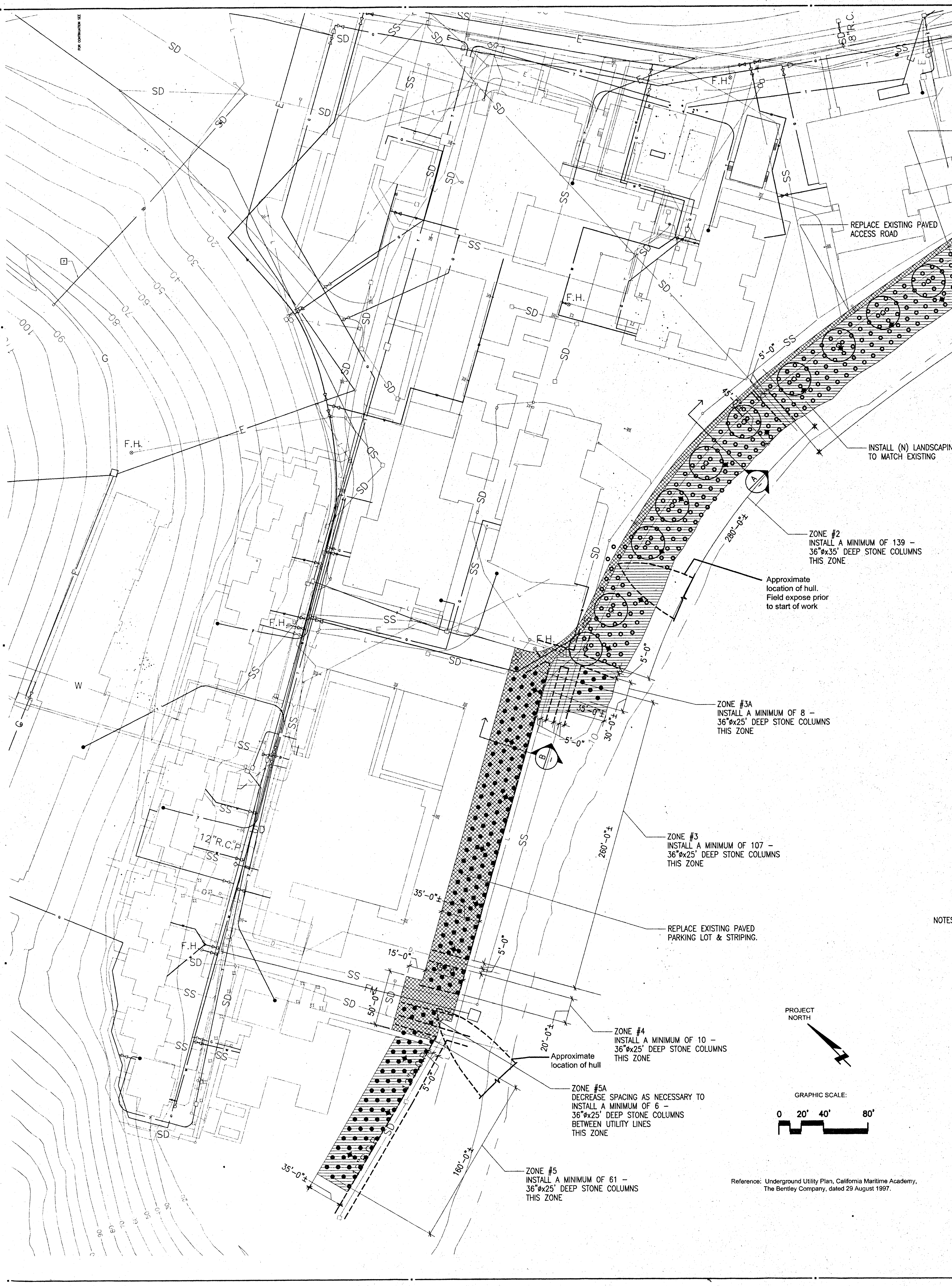
Shoreline Looking West Towards Dining Center

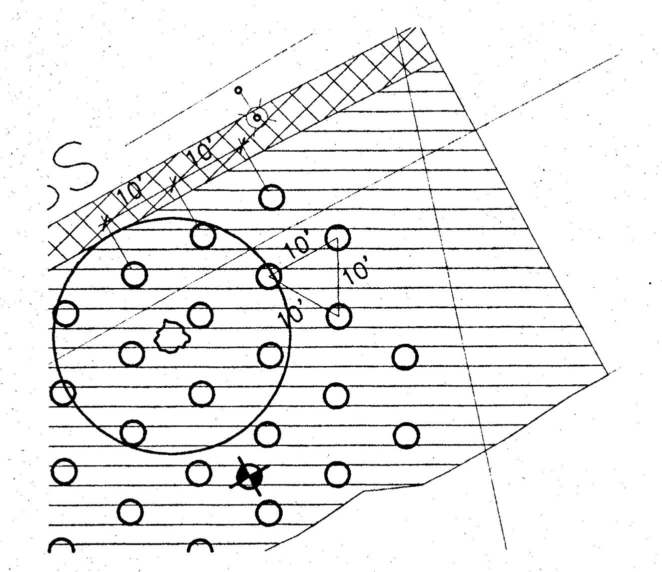
Source: Provided by WRA 2022

Shoreline Looking East Towards Steam Plant Simulator and Boathouse

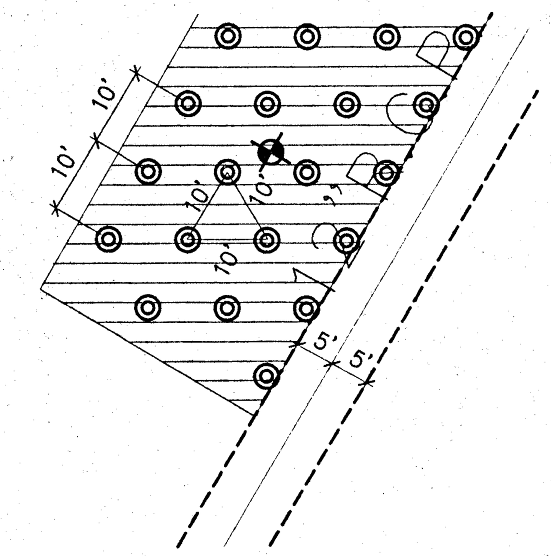
Appendix C

Stone Column Drawings

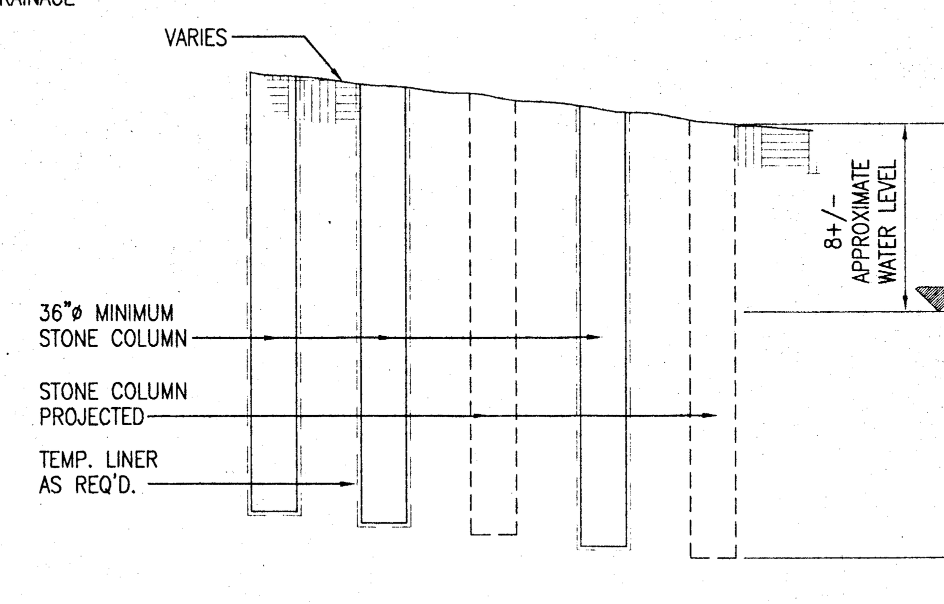




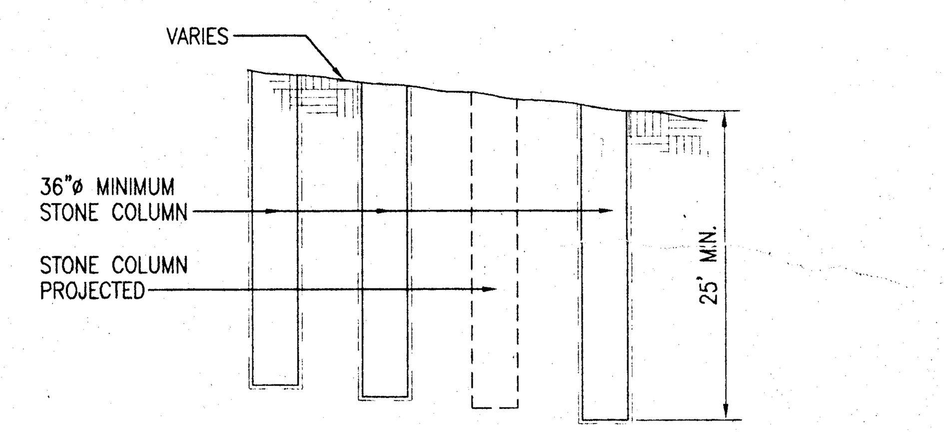
C ENLARGE PLAN DETAIL
TYPICAL 5 ROWS



D ENLARGE PLAN DETAIL
TYPICAL 4 ROWS



A STONE COLUMN CROSS SECTION
5 ROWS



B STONE COLUMN CROSS SECTION
4 ROWS

PROJECT
NORTH

GRAPHIC SCALE:
0 20' 40' 80'

Reference: Underground Utility Plan, California Maritime Academy, The Bentley Company, dated 29 August 1997.

EXPLANATION

- o STONE COLUMN EXTENDING TO A DEPTH OF 35 FEET BELOW THE GROUND SURFACE
- • STONE COLUMN EXTENDING TO A DEPTH OF 25 FEET BELOW THE GROUND SURFACE
- ✦ BORING/ CONE PENETROMETE TEST LOCATION TO VERIFY SOIL IMPROVEMENT

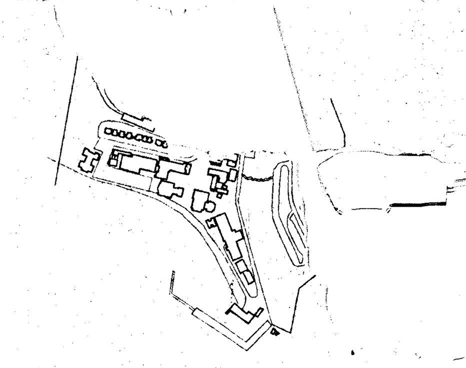
NOTES:

1. THE STONE COLUMNS SHALL BE PLACED IN A TRIANGULAR PATTERN AT 10–FOOT SPACING. THE MINIMUM DIAMETER OF STONE COLUMNS SHALL BE 36 INCHES.
2. UTILITY LINE AND HULL LOCATIONS ARE APPROXIMATE. CONTRACTOR SHALL VERIFY ACTUAL LOCATIONS IN THE FIELD.
3. STONE COLUMNS SHALL BE NO CLOSER THAN 5 FEET CLEAR FROM THE UTILITY LINE. STONE COLUMNS SHALL BE RELOCATED AS DIRECTED BY GEOTECHNICAL ENGINEER.
4. THE GEOTECHNICAL ENGINEER WILL PERFORM POST–DENSIFICATION TESTS TO VERIFY SOIL IMPROVEMENT.
5. CONTRACTOR SHALL FIELD VERIFY & DAYLIGHT EXACT LOCATION OF ALL EXISTING UTILITY LINES WITHIN THE LIMITS OF THE WORK. ALL DAYLIGHTED UTILITY LINES SHALL BE BACKFILLED W/ AGGREGATE PER SPECIFICATION SECT. 02250.
6. CONTRACTOR TO ASSUME THAT ALL STONE COLUMN HOLES WILL ENCOUNTER SIGNIFICANT GROUND WATER INTRUSION AND FLOWS, SEE SPECIFICATIONS FOR KEEPING EXCAVATIONS FREE FROM STANDING WATER.
7. CONTRACTOR SHALL INCLUDE ALL NECESSARY TEMPORARY EXCAVATION LINES TO COMPLETE THE WORK AS PART OF THE LUMP SUM BID.
8. DIAMETERS NOTED ARE MINIMUMS, LENGTHS NOTED ARE MINIMUMS BELOW EXISTING GRADES, OVERSIZE DIAMETER, INCREASED LENGTHS OR CHANGES IN NUMBERS OF STONE COLUMNS TO CONFORM TO SPECIFICATIONS.
9. CONTRACTOR TO INSTALL STONE COLUMNS IN A SINGLE LINE OF 40+/– STONE COLUMNS CLOSEST TO THE SHORE LINE STARTING AT EAST END AND HEADING WEST. THEN INSTALL NEXT ROW OF 40+/– CLOSEST TO THE INSTALLED LINE. THEN COMPLETE INSTALLATION OF REMAINING ROWS BEFORE MOVING WEST TO NEXT ZONE. AS AN ALTERNATE CONTRACTOR MAY PROPOSE DIFFERENT SEQUENCE FOR REVIEW AND COMMENT.

- NEW 2" AC PAVING 0/6" AGG. BASE.
- NEW LANDSCAPING & IRRIGATION TO MATCH EXISTING
- EXISTING PALM TREES (TOTAL OF 14) TO REMAIN. PROTECT PER SPECIFICATIONS. STONE COLUMNS SHALL NOT BE LOCATED WITHIN 5-FEET OF TREE TRUNK

555 MONTG...
SAN FRANCIS...

NO.	REVISION	DATE



KEY PLAN

SEISMIC UPGRADE
FOR VARIOUS BUILDINGS
CAMPUSWIDE
PROJECT NO. 772555

CALIFORNIA MARITIME ACADEMY
VALLEJO, CA

Sheet Title:

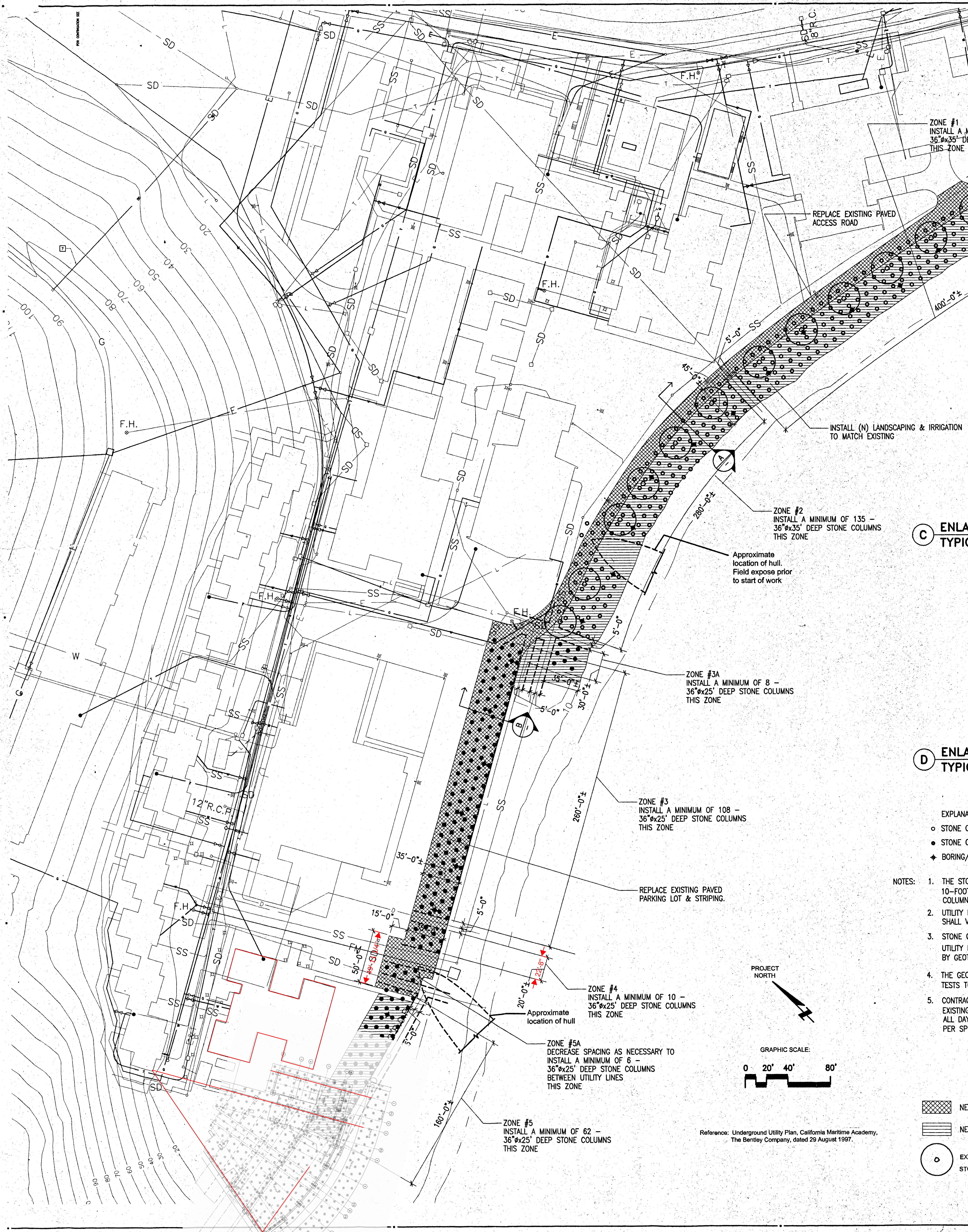
SITE DENSIFICATION

Scale:	1"=40'-0"
Project Number:	98017
Designed By:	—
Drawn By:	CS
Checked By:	RSJ
Date:	1-11-99

Sheet Number

C.1

UPDATED:



PROJECT NORTH

GRAPHIC SCALE:

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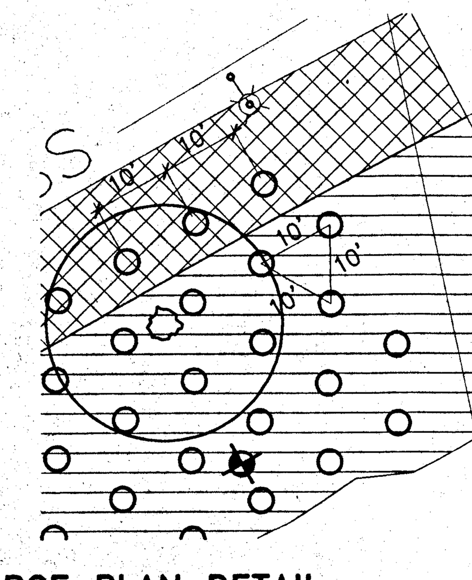
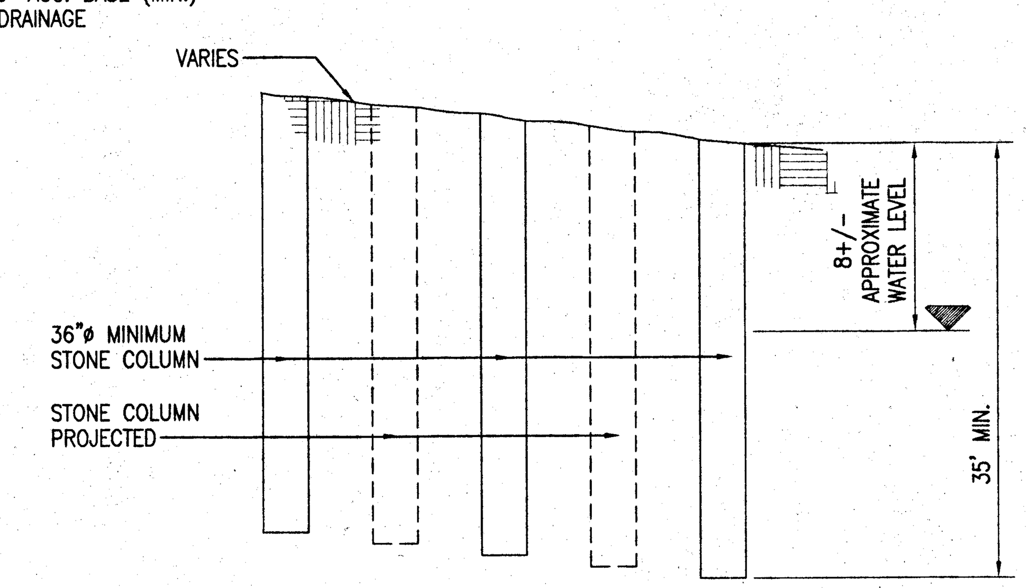
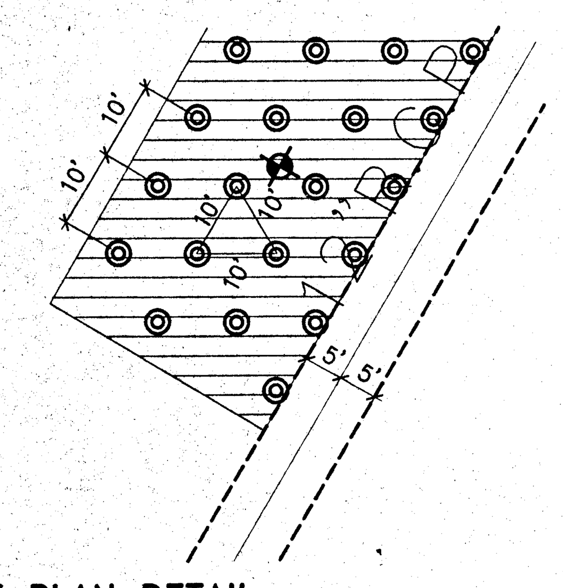


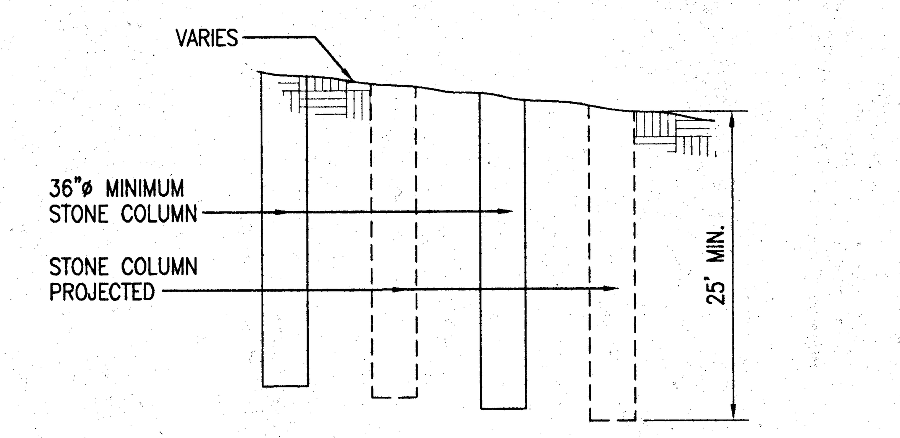
C ENLARGE PLAN DETAIL
TYPICAL 5 ROWS



A STONE COLUMN CROSS SECTION
5 ROWS



D ENLARGE PLAN DETAIL
TYPICAL 4 ROWS



B STONE COLUMN CROSS SECTION
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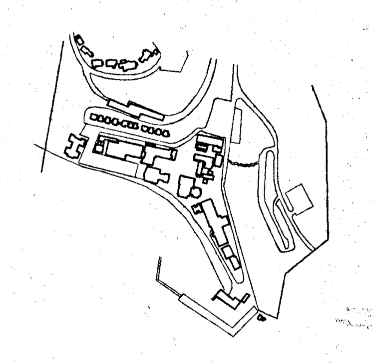
CALIFORNIA MARITIME ACADEMY
THE CALIFORNIA STATE UNIVERSITY
VALLEJO, CALIFORNIA

Treadwell&Rollo
555 MONTGOMERY STREET, SUITE 1300
SAN FRANCISCO, CALIFORNIA, 94111

NO.	REVISION	DATE



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C.1

31 Of 31 Sheets

UPDATED: 2/17/99 2:15 PM

Appendix D

Air Quality, GHG, and Energy Model Outputs

AQ Daily Tables

Total

		Total Tons						Average Lbs Per Day				
		ROG	NOX	CO	PM10 ex	PM2.5 ex	Working Days	ROG	NOX	CO	PM10 ex	PM2.5 ex
Phase 1	2025	0.15	3.47	1.28	0.08	0.07	170	1.72	40.78	15.01	0.93	0.88
	2026	0.18	3.70	1.65	0.09	0.08	303	1.17	24.45	10.90	0.58	0.55
Phase 2	2027	0.23	5.14	2.44	0.13	0.12	312	1.45	32.95	15.63	0.83	0.78
Phase 3	2030	0.34	4.56	2.08	0.11	0.11	312	2.20	29.22	13.32	0.72	0.68
	2031	0.14	2.44	2.83	0.09	0.09	312	0.87	15.64	18.11	0.61	0.56
	2032	0.06	1.23	0.94	0.04	0.04	145	0.87	17.00	12.98	0.53	0.50
Threshold (daily)								54	54	-	82	54
Exceeds Threshold?								NO	NO	-	NO	NO

By Phase for EIR section

	Total Tons						Average Lbs Per Day			
	ROG	NOX	CO	PM10 ex	PM2.5 ex	Working Days	ROG	NOX	PM10 ex	PM2.5 ex
Ph1	0.32	7.17	2.93	0.17	0.16	473	1	30	1	1
Ph2	0.23	5.14	2.44	0.13	0.12	312	1	33	1	1
Ph3	0.54	8.23	5.84	0.25	0.23	769	1	21	1	1

squish const to early in time period re; Efs
total emission/ total days = conservative result

Offroad

		Total Tons						Average Lbs Per Day				
		ROG	NOX	CO	PM10 ex	PM2.5 ex	Working Days	ROG	NOX	CO	PM10 ex	PM2.5 ex
Phase 1	2025	0.019	0.50	0.36	2E-02	2E-02	170	0.23	5.84	4.19	0.23	0.21
	2026	0.027	0.71	0.53	3E-02	3E-02	303	0.18	4.67	3.50	0.18	0.17
Phase 2	2027	0.052	1.37	1.17	5E-02	5E-02	312	0.34	8.80	7.53	0.34	0.32
Phase 3	2030	0.043	1.12	0.96	4E-02	4E-02	312	0.28	7.19	6.16	0.28	0.26
	2031	0.090	2.40	2.45	9E-02	9E-02	312	0.58	15.41	15.70	0.60	0.55
	2032	0.027	0.73	0.67	3E-02	3E-02	145	0.38	10.04	9.25	0.39	0.36

Onroad

		Total Tons						Average Lbs Per Day				
		ROG	NOX	CO	PM10 ex	PM2.5 ex	Working Days	ROG	NOX	CO	PM10 ex	PM2.5 ex
Phase 1	2025	0.033	0.03	0.30	5E-04	4E-04	170	0.39	0.40	3.50	0.01	0.01
	2026	0.056	0.06	0.50	9E-04	8E-04	303	0.37	0.41	3.29	0.01	0.01
Phase 2	2027	0.055	0.06	0.48	9E-04	8E-04	312	0.35	0.38	3.06	0.01	0.01
Phase 3	2030	0.047	0.04	0.40	6E-04	6E-04	312	0.30	0.24	2.54	0.00	0.00
	2031	0.045	0.04	0.38	6E-04	6E-04	312	0.29	0.23	2.41	0.00	0.00
	2032	0.020	0.01	0.16	2E-04	2E-04	145	0.27	0.18	2.27	0.00	0.00

Harbor Craft

		Total Tons						Average Lbs Per Day				
		ROG	NOX	CO	PM10 ex	PM2.5 ex	Working Days	ROG	NOX	CO	PM10 ex	PM2.5 ex
Phase 1	2025	0.094	2.936	0.62	6E-02	6E-02	170	1.11	34.54	7.32	0.70	0.67
	2026	0.094	2.936	0.62	6E-02	6E-02	303	0.62	19.38	4.11	0.39	0.37
Phase 2	2027	0.119	3.71	0.79	7E-02	7E-02	312	0.76	23.77	5.04	0.48	0.46
Phase 3	2030	0.109	3.40	0.72	7E-02	7E-02	312	0.70	21.79	4.62	0.44	0.42
	2031	0.000	0.00	0.00	0E+00	0E+00	312	0.00	0.00	0.00	0.00	0.00
	2032	0.016	0.49	0.11	1E-02	1E-02	145	0.22	6.78	1.45	0.14	0.13

Coatings

		Total Tons						Average Lbs Per Day				
		ROG	NOX	CO	PM10 ex	PM2.5 ex	Working Days	ROG	NOX	CO	PM10 ex	PM2.5 ex
Phase 1	2025											
	2026											
Phase 2	2027											
Phase 3	2030	0.1										
	2031											
	2032											

GHG Table

Total

		Total Metric Tons
		CO2e
Phase 1	2025	566
	2026	663
Phase 2	2027	905
Phase 3	2030	797
	2031	594
	2032	261

	CO2e
Phase 1	1,230
Phase 2	905
Phase 3	1,652
	3,786

Offroad

		Total Metric Tons
		CO2e
Phase 1	2025	103
	2026	145
Phase 2	2027	280
Phase 3	2030	230
	2031	484
	2032	146

Onroad

		Total Metric Tons
		CO2e
Phase 1	2025	71
	2026	126
Phase 2	2027	128
Phase 3	2030	112
	2031	110
	2032	48

Harbor Craft

		Total Metric Tons
		CO2e
Phase 1	2025	393
	2026	393
Phase 2	2027	496
Phase 3	2030	455
	2031	0
	2032	66

Offroad Calculations

Summary - Offroad Emissions

		Total Tons						Average Lbs Per Day					
		ROG	NOX	CO	PM10 ex	PM2.5 ex	Working Days	ROG	NOX	CO	PM10 ex	PM2.5 ex	
Phase 1	2025	0.019	0.50	0.36	0.02	0.02	170	0.23	5.84	4.19	0.23	0.21	1
	2026	0.027	0.71	0.53	0.03	0.03	303	0.18	4.67	3.50	0.18	0.17	1
Phase 2	2027	0.052	1.37	1.17	0.05	0.05	312	0.34	8.80	7.53	0.34	0.32	2
Phase 3	2030	0.043	1.12	0.96	0.04	0.04	312	0.28	7.19	6.16	0.28	0.26	3
	2031	0.090	2.40	2.45	0.09	0.09	312	0.58	15.41	15.70	0.60	0.55	3
	2032	0.027	0.73	0.67	0.03	0.03	145	0.38	10.04	9.25	0.39	0.36	3
		0.259	6.831	6.141	0.266	0.245							

GHG		Total MT
		CO2e
Phase 1	2025	103
	2026	145
Phase 2	2027	280
Phase 3	2030	230
	2031	484
	2032	146
Total		1388

Gallons		
		Diesel
Total		135476

	Emisssions (in total tons)								Working			Average Lbs per day							
	ROG	NOX	CO	PM10 ex	PM10 d	PM2.5 ex	PM2.5 d	SOx	Days	Phase	Year	ROG	NOX	CO	PM10 ex	PM10 d	PM2.5 ex	PM2.5 d	SOx
1-1_2025	0.005	0.1	0.1	0.0	0.0	0.0	0.0	0.0	60	1	2025	0.169	4.355	3.121	0.169		0.155		0.009
1-2_2025	0.005	0.1	0.1	0.0	0.0	0.0	0.0	0.0	60	1	2025	0.169	4.355	3.121	0.169		0.155		0.009
1-3_2025	0.006	0.2	0.1	0.0	0.0	0.0	0.0	0.0	72	1	2025	0.169	4.355	3.121	0.169		0.155		0.009
1-4_2025	0.003	0.1	0.1	0.0	0.0	0.0	0.0	0.0	36	1	2025	0.169	4.355	3.121	0.169		0.155		0.009
1-5_2026	0.008	0.2	0.1	0.0	0.0	0.0	0.0	0.0	96	1	2026	0.169	4.355	3.073	0.169		0.155		0.009
1-6_2026	0.006	0.2	0.1	0.0	0.0	0.0	0.0	0.0	72	1	2026	0.169	4.355	3.073	0.169		0.155		0.009
1-7_2026	0.005	0.1	0.1	0.0	0.0	0.0	0.0	0.0	60	1	2026	0.169	4.355	3.073	0.169		0.155		0.009
1-8_2026	0.008	0.2	0.2	0.0	0.0	0.0	0.0	0.0	72	1	2026	0.218	5.857	4.981	0.229		0.211		0.012
2-1_2027	0.008	0.2	0.1	0.0	0.0	0.0	0.0	0.0	48	2	2027	0.338	8.710	6.114	0.338		0.311		0.018
2-2_2027	0.007	0.2	0.1	0.0	0.0	0.0	0.0	0.0	84	2	2027	0.169	4.355	3.057	0.169		0.155		0.009
2-3_2027	0.006	0.2	0.1	0.0	0.0	0.0	0.0	0.0	72	2	2027	0.169	4.355	3.057	0.169		0.155		0.009
2-4_2027	0.007	0.2	0.1	0.0	0.0	0.0	0.0	0.0	84	2	2027	0.169	4.355	3.057	0.169		0.155		0.009
2-5_2027	0.024	0.6	0.7	0.0	0.0	0.0	0.0	0.0	96	2	2027	0.501	13.366	13.758	0.523		0.481		0.027
3-1_2030	0.004	0.1	0.1	0.0	0.0	0.0	0.0	0.0	24	3	2030	0.338	8.710	6.023	0.338		0.311		0.018
3-2_2030	0.007	0.2	0.1	0.0	0.0	0.0	0.0	0.0	84	3	2030	0.169	4.355	3.012	0.169		0.155		0.009
3-3_2030	0.003	0.1	0.1	0.0	0.0	0.0	0.0	0.0	36	3	2030	0.169	4.355	3.012	0.169		0.155		0.009
3-4_2030	0.002	0.1	0.0	0.0	0.0	0.0	0.0	0.0	24	3	2030	0.169	4.355	3.012	0.169		0.155		0.009
3-5_2030	0.008	0.2	0.1	0.0	0.0	0.0	0.0	0.0	96	3	2030	0.169	4.355	3.012	0.169		0.155		0.009
3-6_2030	0.019	0.5	0.5	0.0	0.0	0.0	0.0	0.0	51	3	2030	0.734	19.372	20.687	0.756		0.695		0.040
3-6_2031	0.012	0.3	0.3	0.0	0.0	0.0	0.0	0.0	33	3	2031	0.734	19.372	20.301	0.756		0.695		0.040
3-7_2031	0.078	2.1	2.1	0.1	0.0	0.1	0.0	0.0	312	3	2031	0.501	13.366	13.557	0.523		0.481		0.027
3-7_2032	0.021	0.6	0.5	0.0	0.0	0.0	0.0	0.0	84	3	2032	0.501	13.366	12.784	0.523		0.481		0.027
3-8_2032	0.003	0.1	0.1	0.0	0.0	0.0	0.0	0.0	36	3	2032	0.169	4.355	2.924	0.169		0.155		0.009
3-9_2032	0.003	0.1	0.1	0.0	0.0	0.0	0.0	0.0	24	3	2032	0.268	7.359	6.756	0.290		0.266		0.015
	0.259	6.831	6.141	0.266	0.000	0.245	0.000	0.014											

	Emissions (in MT per year)					
	CO2	CH4	N2O	CO2e	*Phase*	*Year*
1-1_2025	27.0	0.0	0.0	27.0	1	2025
1-2_2025	27.0	0.0	0.0	27.0	1	2025
1-3_2025	32.3	0.0	0.0	32.5	1	2025
1-4_2025	16.2	0.0	0.0	16.2	1	2025
1-5_2026	43.1	0.0	0.0	43.3	1	2026
1-6_2026	32.3	0.0	0.0	32.4	1	2026
1-7_2026	26.9	0.0	0.0	27.0	1	2026
1-8_2026	41.8	0.0	0.0	42.0	1	2026
2-1_2027	43.1	0.0	0.0	43.3	2	2027
2-2_2027	37.7	0.0	0.0	37.9	2	2027
2-3_2027	32.3	0.0	0.0	32.4	2	2027
2-4_2027	37.7	0.0	0.0	37.9	2	2027
2-5_2027	128.4	0.0	0.0	128.9	2	2027
3-1_2030	21.6	0.0	0.0	21.6	3	2030
3-2_2030	37.7	0.0	0.0	37.9	3	2030
3-3_2030	16.2	0.0	0.0	16.2	3	2030
3-4_2030	10.8	0.0	0.0	10.8	3	2030
3-5_2030	43.1	0.0	0.0	43.3	3	2030
3-6_2030	100.1	0.0	0.0	100.5	3	2030
3-6_2031	64.8	0.0	0.0	65.0	3	2031
3-7_2031	417.3	0.0	0.0	418.8	3	2031
3-7_2032	112.4	0.0	0.0	112.8	3	2032
3-8_2032	16.2	0.0	0.0	16.2	3	2032
3-9_2032	17.1	0.0	0.0	17.2	3	2032

OFFROAD EQUIPMENT

				Equipment Specs									Total Emisssions (in tons)											Emissions (in MT)					
Phase	Activity	Year	Working days	Equipment	OFFROAD Match	#	HP	Hrs/day	Load Factor	Daily hp-hrs (# * HP * hrs * LF)	Total hp-hrs (Daily hphrs * days)	HP Bin (for EF lookup)	ROG	NOX	CO	PM10 ex	PM10 d	PM2.5 ex	PM2.5 d	SOx	CO2	CH4	N2O	CO2	CH4	N2O	CO2e	Fuel Gallons	Diesel PM (tons)
1-1	Demolition (Over-Water)	2025	60	Derrick Barge w/ Crane	Cranes	1	367	8	0.29	851	51,086	599.99	0.0	0.13	0.1	0.0	0.0	0.0	0.0	0.0	29.7	0.0	0.0	27.0	0.0	0.0	27.0	2640	4.66E-03
1-2	Demolition (In-Water)	2025	60	Derrick Barge w/ Crane	Cranes	1	367	8	0.29	851	51,086	599.99	0.0	0.13	0.1	0.0	0.0	0.0	0.0	0.0	29.7	0.0	0.0	27.0	0.0	0.0	27.0	2640	4.66E-03
1-3	Pier (In-Water)	2025	72	Derrick Barge w/ Crane	Cranes	1	367	8	0.29	851	61,304	599.99	0.0	0.16	0.1	0.0	0.0	0.0	0.0	0.0	35.7	0.0	0.0	32.3	0.0	0.0	32.5	3168	5.60E-03
1-4	Breakwater/Dolphin (In-Water)	2025	36	Derrick Barge w/ Crane	Cranes	1	367	8	0.29	851	30,652	599.99	0.0	0.08	0.1	0.0	0.0	0.0	0.0	0.0	17.8	0.0	0.0	16.2	0.0	0.0	16.2	1584	2.80E-03
1-5	Pier (Over-Water)	2026	96	Derrick Barge w/ Crane	Cranes	1	367	8	0.29	851	81,738	599.99	0.0	0.21	0.1	0.0	0.0	0.0	0.0	0.0	47.5	0.0	0.0	43.1	0.0	0.0	43.3	4223	7.46E-03
1-6	Breakwater/Dolphin (Over-Water)	2026	72	Derrick Barge w/ Crane	Cranes	1	367	8	0.29	851	61,304	599.99	0.0	0.16	0.1	0.0	0.0	0.0	0.0	0.0	35.6	0.0	0.0	32.3	0.0	0.0	32.4	3167	5.60E-03
1-7	Small Boat Basin	2026	60	Derrick Barge w/ Crane	Cranes	1	367	8	0.29	851	51,086	599.99	0.0	0.13	0.1	0.0	0.0	0.0	0.0	0.0	29.7	0.0	0.0	26.9	0.0	0.0	27.0	2639	4.66E-03
1-8	Marine Yard	2026	72	Crane	Cranes	1	367	8	0.29	851	61,304	599.99	0.0	0.16	0.1	0.0	0.0	0.0	0.0	0.0	35.6	0.0	0.0	32.3	0.0	0.0	32.4	3167	5.60E-03
1-8	Marine Yard	2026	72	Excavator/Backhoe	Tractors/Loaders/Backhoes	1	84	8	0.37	249	17,902	99.99	0.0	0.05	0.1	0.0	0.0	0.0	0.0	0.0	10.5	0.0	0.0	9.5	0.0	0.0	9.5	929	2.00E-03
1-8	Marine Yard	2026	72	Dozer	Rubber tired dozers	0	367	8	0.40	0	0	599.99	0.0	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0.00E+00
2-1	Dredging	2027	48	Derrick Barge w/ Crane	Cranes	2	367	8	0.29	1,703	81,738	599.99	0.0	0.21	0.1	0.0	0.0	0.0	0.0	0.0	47.5	0.0	0.0	43.1	0.0	0.0	43.3	4223	7.46E-03
2-2	Dock / Breakwater (In-Water)	2027	84	Derrick Barge w/ Crane	Cranes	1	367	8	0.29	851	71,521	599.99	0.0	0.18	0.1	0.0	0.0	0.0	0.0	0.0	41.6	0.0	0.0	37.7	0.0	0.0	37.9	3695	6.53E-03
2-3	Dock / Breakwater (Over-Water)	2027	72	Derrick Barge w/ Crane	Cranes	1	367	8	0.29	851	61,304	599.99	0.0	0.16	0.1	0.0	0.0	0.0	0.0	0.0	35.6	0.0	0.0	32.3	0.0	0.0	32.4	3167	5.60E-03
2-4	Small Boat Basin #2	2027	84	Derrick Barge w/ Crane	Cranes	1	367	8	0.29	851	71,521	599.99	0.0	0.18	0.1	0.0	0.0	0.0	0.0	0.0	41.6	0.0	0.0	37.7	0.0	0.0	37.9	3695	6.53E-03
2-5	Marine/Naval Modulars	2027	96	Crane	Cranes	1	367	8	0.29	851	81,738	599.99	0.0	0.21	0.1	0.0	0.0	0.0	0.0	0.0	47.5	0.0	0.0	43.1	0.0	0.0	43.3	4223	7.46E-03
2-5	Marine/Naval Modulars	2027	96	Excavator/Backhoe	Tractors/Loaders/Backhoes	2	84	8	0.37	497	47,739	99.99	0.0	0.14	0.2	0.0	0.0	0.0	0.0	0.0	27.9	0.0	0.0	25.3	0.0	0.0	25.4	2476	5.33E-03
2-5	Marine/Naval Modulars	2027	96	Dozer	Rubber tired dozers	1	367	8	0.40	1,174	112,742	599.99	0.0	0.29	0.3	0.0	0.0	0.0	0.0	0.0	66.2	0.0	0.0	60.0	0.0	0.0	60.2	5881	1.03E-02
3-1	Dredging	2030	24	Derrick Barge w/ Crane	Cranes	2	367	8	0.29	1,703	40,869	599.99	0.0	0.10	0.1	0.0	0.0	0.0	0.0	0.0	23.8	0.0	0.0	21.6	0.0	0.0	21.6	2112	3.73E-03
3-2	Breakwaters (In-Water)	2030	84	Derrick Barge w/ Crane	Cranes	1	367	8	0.29	851	71,521	599.99	0.0	0.18	0.1	0.0	0.0	0.0	0.0	0.0	41.6	0.0	0.0	37.7	0.0	0.0	37.9	3696	6.53E-03
3-3	Observation Docks	2030	36	Derrick Barge w/ Crane	Cranes	1	367	8	0.29	851	30,652	599.99	0.0	0.08	0.1	0.0	0.0	0.0	0.0	0.0	17.8	0.0	0.0	16.2	0.0	0.0	16.2	1584	2.80E-03
3-4	Row House (In-Water)	2030	24	Derrick Barge w/ Crane	Cranes	1	367	8	0.29	851	20,435	599.99	0.0	0.05	0.0	0.0	0.0	0.0	0.0	0.0	11.9	0.0	0.0	10.8	0.0	0.0	10.8	1056	1.87E-03
3-5	Row House (Over-Water)	2030	96	Derrick Barge w/ Crane	Cranes	1	367	8	0.29	851	81,738	599.99	0.0	0.21	0.1	0.0	0.0	0.0	0.0	0.0	47.5	0.0	0.0	43.1	0.0	0.0	43.3	4224	7.46E-03
3-6	Marine Yard Upgrades	2030	51	Crane	Cranes	1	367	8	0.29	851	43,423	599.99	0.0	0.11	0.1	0.0	0.0	0.0	0.0	0.0	25.3	0.0	0.0	22.9	0.0	0.0	23.0	2244	3.96E-03
3-6	Marine Yard Upgrades	2030	51	Excavator/Backhoe	Tractors/Loaders/Backhoes	2	84	8	0.37	497	25,361	99.99	0.0	0.08	0.1	0.0	0.0	0.0	0.0	0.0	14.8	0.0	0.0	13.4	0.0	0.0	13.5	1315	2.83E-03
3-6	Marine Yard Upgrades	2030	51	Dozer	Rubber tired dozers	2	367	8	0.40	2,349	119,789	599.99	0.0	0.31	0.4	0.0	0.0	0.0	0.0	0.0	70.3	0.0	0.0	63.8	0.0	0.0	64.0	6246	1.09E-02
3-6	Marine Yard Upgrades	2031	33	Crane	Cranes	1	367	8	0.29	851	28,098	599.99	0.0	0.07	0.0	0.0	0.0	0.0	0.0	0.0	16.3	0.0	0.0	14.8	0.0	0.0	14.9	1452	2.56E-03
3-6	Marine Yard Upgrades	2031	33	Excavator/Backhoe	Tractors/Loaders/Backhoes	2	84	8	0.37	497	16,410	99.99	0.0	0.05	0.1	0.0	0.0	0.0	0.0	0.0	9.6	0.0	0.0	8.7	0.0	0.0	8.7	851	1.83E-03
3-6	Marine Yard Upgrades	2031	33	Dozer	Rubber tired dozers	2	367	8	0.40	2,349	77,510	599.99	0.0	0.20	0.2	0.0	0.0	0.0	0.0	0.0	45.5	0.0	0.0	41.3	0.0	0.0	41.4	4042	7.07E-03
3-7	New Building	2031	312	Crane	Cranes	1	367	8	0.29	851	265,649	599.99	0.0	0.68	0.5	0.0	0.0	0.0	0.0	0.0	154.5	0.0	0.0	140.2	0.0	0.0	140.6	13728	2.42E-02
3-7	New Building	2031	312	Excavator/Backhoe	Tractors/Loaders/Backhoes	2	84	8	0.37	497	155,151	99.99	0.0	0.47	0.6	0.0	0.0	0.0	0.0	0.0	90.5	0.0	0.0	82.1	0.0	0.0	82.4	8043	1.73E-02
3-7	New Building	2031	312	Dozer	Rubber tired dozers	1	367	8	0.40	1,174	366,413	599.99	0.0	0.94	1.1	0.0	0.0	0.0	0.0	0.0	215.0	0.0	0.0	195.1	0.0	0.0	195.7	19106	3.34E-02
3-7	New Building	2032	84	Crane	Cranes	1	367	8	0.29	851	71,521	599.99	0.0	0.18	0.1	0.0	0.0	0.0	0.0	0.0	41.6	0.0	0.0	37.7	0.0	0.0	37.9	3696	6.53E-03
3-7	New Building	2032	84	Excavator/Backhoe	Tractors/Loaders/Backhoes	2	84	8	0.37	497	41,772	99.99	0.0	0.13	0.2	0.0	0.0	0.0	0.0	0.0	24.4	0.0	0.0	22.1	0.0	0.0	22.2	2165	4.66E-03
3-7	New Building	2032	84	Dozer	Rubber tired dozers	1	367	8	0.40	1,174	98,650	599.99	0.0	0.25	0.3	0.0	0.0	0.0	0.0	0.0	57.9	0.0	0.0	52.5	0.0	0.0	52.7	5144	9.00E-03
3-8	Hydro Kinetic Barge (in-Water)	2032	36	Derrick Barge w/ Crane	Cranes	1	367	8	0.29	851	30,652	599.99	0.0	0.08	0.1	0.0	0.0	0.0	0.0	0.0	17.8	0.0	0.0	16.2	0.0	0.0	16.2	1584	2.80E-03
3-9	Hydro Kinetic Barge (Over-Water)	2032	24	Crane	Cranes	1	367	8	0.29	851	20,435	599.99	0.0	0.05	0.0	0.0	0.0	0.0	0.0	0.0	11.9	0.0	0.0	10.8	0.0	0.0	10.8	1056	1.87E-03
3-9	Hydro Kinetic Barge (Over-Water)	2032	24	Excavator/Backhoe	Tractors/Loaders/Backhoes	2	84	8	0.37	497	11,935	99.99	0.0	0.04	0.0	0.0	0.0	0.0	0.0	0.0	7.0	0.0	0.0	6.3	0.0	0.0	6.3	619	1.33E-03

Table G-12. Horsepower and Load Factors for Construction Equipment by Fuel Type

Equipment	Fuel	Horsepower	Load Factor
Aerial Lifts	Diesel	46	0.31
Air Compressors	Diesel	37	0.48
Bore/Drill Rigs	Diesel	83	0.50
Cement and Mortar Mixers	Diesel	10	0.56
Concrete/Industrial Saws	Diesel	33	0.73
Cranes	Diesel	367	0.29
Crawler Tractors	Diesel	87	0.43
Dumpers/Tenders	Diesel	16	0.38
Excavators	Diesel	36	0.38
Forklifts	Diesel	82	0.20
Generator Sets	Diesel	14	0.74
Graders	Diesel	148	0.41
Off-Highway Tractors	Diesel	38	0.44
Off-Highway Trucks	Diesel	376	0.38
Other Construction Equipment	Diesel	82	0.42
Other General Industrial Equipment	Diesel	35	0.34
Other Material Handling Equipment	Diesel	93	0.40
Pavers	Diesel	81	0.42
Paving Equipment	Diesel	89	0.36
Plate Compactors	Diesel	8	0.43
Pressure Washers	Diesel	14	0.30
Pumps	Diesel	11	0.74
Rollers	Diesel	36	0.38
Rough Terrain Forklifts	Diesel	96	0.40
Rubber Tired Dozers	Diesel	367	0.40
Rubber Tired Loaders	Diesel	150	0.36
Scrapers	Diesel	423	0.48
Signal Boards	Diesel	6	0.82
Skid Steer Loaders	Diesel	71	0.37
Surfacing Equipment	Diesel	399	0.30
Sweepers/Scrubbers	Diesel	36	0.46
Tractors/Loaders/Backhoes	Diesel	84	0.37
Trenchers	Diesel	40	0.50
Welders	Diesel	46	0.45

Source:Caleemod 2022, Appx G, Table G-12

Unmitigated EFs from Caleemod 2022 (based on OFFROAD 2017) Appx G, Table G-11

Equipment	Year	Low HP	High HP	TOG	ROG	NOX	CO	SO2	PM10	PM2.5	CO2	CH4	N2O
Aerial Lifts	2025	0	25	1.013	0.837	6.391	4.044	0.012	0.246	0.226	848.507	0.034	0.007
Aerial Lifts	2025	25	50	0.183	0.154	2.877	3.086	0.005	0.021	0.019	586.900	0.024	0.005
Aerial Lifts	2025	50	75	0.116	0.098	1.532	3.145	0.005	0.028	0.026	527.864	0.021	0.004
Aerial Lifts	2025	75	100	0.120	0.101	1.471	3.205	0.005	0.022	0.020	528.027	0.021	0.004
Aerial Lifts	2025	100	175	0.101	0.085	0.571	2.845	0.005	0.024	0.022	527.719	0.021	0.004
Aerial Lifts	2025	175	300	0.100	0.084	0.687	0.974	0.005	0.009	0.009	527.713	0.021	0.004
Aerial Lifts	2025	300	600	0.081	0.068	0.264	0.963	0.005	0.009	0.009	527.713	0.021	0.004
Aerial Lifts	2026	0	25	1.012	0.837	6.384	4.043	0.012	0.245	0.225	848.422	0.034	0.007
Aerial Lifts	2026	25	50	0.181	0.152	2.874	3.075	0.005	0.021	0.019	586.900	0.024	0.005
Aerial Lifts	2026	50	75	0.122	0.103	1.553	3.162	0.005	0.031	0.028	527.871	0.021	0.004
Aerial Lifts	2026	75	100	0.106	0.089	1.415	3.161	0.005	0.016	0.015	527.893	0.021	0.004
Aerial Lifts	2026	100	175	0.099	0.084	0.571	2.837	0.005	0.024	0.022	527.719	0.021	0.004
Aerial Lifts	2026	175	300	0.104	0.088	0.689	0.979	0.005	0.009	0.009	527.713	0.021	0.004
Aerial Lifts	2026	300	600	0.084	0.071	0.265	0.968	0.005	0.009	0.009	527.713	0.021	0.004
Aerial Lifts	2027	0	25	1.012	0.837	6.381	4.044	0.012	0.244	0.224	848.575	0.034	0.007
Aerial Lifts	2027	25	50	0.180	0.151	2.870	3.070	0.005	0.020	0.019	586.901	0.024	0.005
Aerial Lifts	2027	50	75	0.127	0.106	1.548	3.181	0.005	0.030	0.028	527.867	0.021	0.004
Aerial Lifts	2027	75	100	0.098	0.083	1.409	3.128	0.005	0.017	0.015	527.884	0.021	0.004
Aerial Lifts	2027	100	175	0.100	0.084	0.572	2.841	0.005	0.024	0.022	527.719	0.021	0.004
Aerial Lifts	2027	175	300	0.108	0.091	0.691	0.985	0.005	0.010	0.009	527.713	0.021	0.004
Aerial Lifts	2027	300	600	0.087	0.073	0.266	0.973	0.005	0.009	0.009	527.713	0.021	0.004
Aerial Lifts	2028	0	25	1.012	0.836	6.378	4.043	0.012	0.243	0.224	848.471	0.034	0.007
Aerial Lifts	2028	25	50	0.180	0.151	2.871	3.075	0.005	0.020	0.018	586.903	0.024	0.005
Aerial Lifts	2028	50	75	0.130	0.109	1.545	3.198	0.005	0.031	0.029	527.851	0.021	0.004
Aerial Lifts	2028	75	100	0.094	0.079	1.406	3.112	0.005	0.015	0.014	527.892	0.021	0.004
Aerial Lifts	2028	100	175	0.095	0.080	0.541	2.819	0.005	0.024	0.022	527.719	0.021	0.004
Aerial Lifts	2028	175	300	0.112	0.094	0.694	0.991	0.005	0.010	0.009	527.713	0.021	0.004
Aerial Lifts	2028	300	600	0.090	0.076	0.267	0.977	0.005	0.010	0.009	527.713	0.021	0.004
Aerial Lifts	2029	0	25	1.012	0.836	6.376	4.043	0.012	0.242	0.223	848.376	0.034	0.007
Aerial Lifts	2029	25	50	0.179	0.151	2.863	3.071	0.005	0.020	0.018	586.898	0.024	0.005
Aerial Lifts	2029	50	75	0.142	0.120	1.618	3.207	0.005	0.040	0.037	527.892	0.021	0.004
Aerial Lifts	2029	75	100	0.098	0.082	1.395	3.140	0.005	0.014	0.012	527.896	0.021	0.004
Aerial Lifts	2029	100	175	0.107	0.090	0.595	2.839	0.005	0.030	0.028	527.721	0.021	0.004
Aerial Lifts	2029	175	300	0.116	0.098	0.696	0.997	0.005	0.010	0.009	527.713	0.021	0.004
Aerial Lifts	2029	300	600	0.094	0.079	0.268	0.982	0.005	0.010	0.009	527.713	0.021	0.004
Aerial Lifts	2030	0	25	1.012	0.836	6.376	4.043	0.012	0.242	0.223	848.458	0.034	0.007
Aerial Lifts	2030	25	50	0.177	0.149	2.860	3.068	0.005	0.019	0.017	586.898	0.024	0.005
Aerial Lifts	2030	50	75	0.142	0.119	1.614	3.206	0.005	0.038	0.035	527.892	0.021	0.004
Aerial Lifts	2030	75	100	0.097	0.082	1.382	3.140	0.005	0.013	0.012	527.896	0.021	0.004
Aerial Lifts	2030	100	175	0.099	0.083	0.573	2.837	0.005	0.026	0.024	527.721	0.021	0.004
Aerial Lifts	2030	175	300	0.096	0.081	0.269	0.997	0.005	0.010	0.009	527.713	0.021	0.004
Aerial Lifts	2030	300	600	0.094	0.079	0.268	0.982	0.005	0.010	0.009	527.713	0.021	0.004
Aerial Lifts	2031	0	25	1.012	0.836	6.377	4.044	0.012	0.242	0.223	848.588	0.034	0.007
Aerial Lifts	2031	25	50	0.176	0.148	2.855	3.067	0.005	0.018	0.017	586.898	0.024	0.005
Aerial Lifts	2031	50	75	0.141	0.118	1.584	3.206	0.005	0.037	0.034	527.892	0.021	0.004
Aerial Lifts	2031	75	100	0.096	0.080	1.376	3.139	0.005	0.013	0.012	527.896	0.021	0.004
Aerial Lifts	2031	100	175	0.096	0.081	0.548	2.836	0.005	0.025	0.023	527.721	0.021	0.004
Aerial Lifts	2031	175	300	0.096	0.081	0.269	0.997	0.005	0.010	0.009	527.713	0.021	0.004
Aerial Lifts	2031	300	600	0.094	0.079	0.268	0.982	0.005	0.010	0.009	527.713	0.021	0.004
Aerial Lifts	2032	0	25	1.012	0.836	6.375	4.043	0.012	0.242	0.222	848.394	0.034	0.007
Aerial Lifts	2032	25	50	0.173	0.145	2.853	3.064	0.005	0.017	0.016	586.898	0.024	0.005
Aerial Lifts	2032	50	75	0.139	0.117	1.565	3.206	0.005	0.036	0.033	527.892	0.021	0.004
Aerial Lifts	2032	75	100	0.095	0.080	1.375	3.139	0.005	0.012	0.011	527.896	0.021	0.004
Aerial Lifts	2032	100	175	0.094	0.079	0.536	2.836	0.005	0.024	0.022	527.721	0.021	0.004
Aerial Lifts	2032	175	300	0.096	0.081	0.269	0.997	0.005	0.010	0.009	527.713	0.021	0.004
Aerial Lifts	2032	300	600	0.094	0.079	0.268	0.982	0.005	0.010	0.009	527.713	0.021	0.004
Aerial Lifts	2033	0	25	1.012	0.836	6.375	4.043	0.012	0.242	0.222	848.336	0.034	0.007
Aerial Lifts	2033	25	50	0.171	0.144	2.852	3.062	0.005	0.017	0.016	586.898	0.024	0.005
Aerial Lifts	2033	50	75	0.130	0.110	1.538	3.202	0.005	0.031	0.028	527.892	0.021	0.004
Aerial Lifts	2033	75	100	0.095	0.080	1.369	3.139	0.005	0.012	0.011	527.896	0.021	0.004
Aerial Lifts	2033	100	175	0.094	0.079	0.536	2.836	0.005	0.024	0.022	527.721	0.021	0.004
Aerial Lifts	2033	175	300	0.096	0.081	0.269	0.997	0.005	0.010	0.009	527.713	0.021	0.004
Aerial Lifts	2033	300	600	0.094	0.079	0.268	0.982	0.005	0.010	0.009	527.713	0.021	0.004
Aerial Lifts	2034	0	25	1.012	0.836	6.376	4.043	0.012	0.242	0.222	848.437	0.034	0.007
Aerial Lifts	2034	25	50	0.166	0.139	2.847	3.057	0.005	0.016	0.014	586.898	0.024	0.005
Aerial Lifts	2034	50	75	0.123	0.103	1.517	3.198	0.005	0.026	0.024	527.892	0.021	0.004
Aerial Lifts	2034	75	100	0.095	0.080	1.369	3.139	0.005	0.012	0.011	527.896	0.021	0.004
Aerial Lifts	2034	100	175	0.092	0.078	0.509	2.834	0.005	0.023	0.021	527.721	0.021	0.004

Unmitigated EFs from Caleemod 2022 (based on OFFROAD 2017) Appx G, Table G-11

Equipment	Year	Low HP	High HP	TOG	ROG	NOX	CO	SO2	PM10	PM2.5	CO2	CH4	N2O
Aerial Lifts	2034	175	300	0.096	0.081	0.269	0.997	0.005	0.010	0.009	527.713	0.021	0.004
Aerial Lifts	2034	300	600	0.094	0.079	0.268	0.982	0.005	0.010	0.009	527.713	0.021	0.004
Aerial Lifts	2035	0	25	1.012	0.836	6.375	4.043	0.012	0.242	0.222	848.407	0.034	0.007
Aerial Lifts	2035	25	50	0.163	0.137	2.844	3.055	0.005	0.015	0.014	586.898	0.024	0.005
Aerial Lifts	2035	50	75	0.118	0.099	1.503	3.196	0.005	0.023	0.021	527.892	0.021	0.004
Aerial Lifts	2035	75	100	0.095	0.080	1.365	3.139	0.005	0.012	0.011	527.896	0.021	0.004
Aerial Lifts	2035	100	175	0.092	0.078	0.509	2.834	0.005	0.023	0.021	527.721	0.021	0.004
Aerial Lifts	2035	175	300	0.096	0.081	0.269	0.997	0.005	0.010	0.009	527.713	0.021	0.004
Aerial Lifts	2035	300	600	0.094	0.079	0.268	0.982	0.005	0.010	0.009	527.713	0.021	0.004
Air Compressors	2025	0	25	0.706	0.584	4.392	2.608	0.008	0.179	0.165	569.768	0.023	0.005
Air Compressors	2025	25	50	0.659	0.545	3.756	4.852	0.007	0.117	0.107	568.363	0.023	0.005
Air Compressors	2026	0	25	0.699	0.578	4.370	2.596	0.008	0.176	0.162	569.493	0.023	0.005
Air Compressors	2026	25	50	0.620	0.512	3.646	4.822	0.007	0.099	0.091	568.287	0.023	0.005
Air Compressors	2027	0	25	0.694	0.573	4.355	2.589	0.008	0.173	0.159	569.699	0.023	0.005
Air Compressors	2027	25	50	0.584	0.482	3.538	4.790	0.007	0.081	0.075	568.322	0.023	0.005
Air Compressors	2028	0	25	0.689	0.570	4.341	2.582	0.008	0.170	0.157	569.672	0.023	0.005
Air Compressors	2028	25	50	0.553	0.457	3.440	4.760	0.007	0.065	0.060	568.340	0.023	0.005
Air Compressors	2029	0	25	0.686	0.567	4.328	2.577	0.008	0.168	0.155	569.538	0.023	0.005
Air Compressors	2029	25	50	0.527	0.436	3.380	4.734	0.007	0.055	0.050	568.309	0.023	0.005
Air Compressors	2030	0	25	0.684	0.565	4.320	2.574	0.008	0.167	0.153	569.588	0.023	0.005
Air Compressors	2030	25	50	0.507	0.419	3.340	4.713	0.007	0.047	0.043	568.322	0.023	0.005
Air Compressors	2031	0	25	0.683	0.564	4.313	2.573	0.008	0.165	0.152	569.416	0.023	0.005
Air Compressors	2031	25	50	0.491	0.406	3.307	4.697	0.007	0.040	0.037	568.343	0.023	0.005
Air Compressors	2032	0	25	0.683	0.564	4.309	2.573	0.008	0.164	0.151	569.407	0.023	0.005
Air Compressors	2032	25	50	0.479	0.396	3.278	4.685	0.007	0.035	0.032	568.283	0.023	0.005
Air Compressors	2033	0	25	0.683	0.564	4.307	2.574	0.008	0.164	0.151	569.580	0.023	0.005
Air Compressors	2033	25	50	0.471	0.389	3.253	4.680	0.007	0.030	0.028	568.338	0.023	0.005
Air Compressors	2034	0	25	0.683	0.564	4.307	2.575	0.008	0.163	0.150	569.799	0.023	0.005
Air Compressors	2034	25	50	0.466	0.385	3.233	4.678	0.007	0.026	0.024	568.397	0.023	0.005
Air Compressors	2035	0	25	0.683	0.564	4.305	2.574	0.008	0.163	0.150	569.747	0.023	0.005
Air Compressors	2035	25	50	0.463	0.383	3.215	4.676	0.007	0.024	0.022	568.382	0.023	0.005
Bore/Drill Rigs	2025	0	25	1.020	0.843	6.436	3.804	0.011	0.242	0.223	850.855	0.035	0.007
Bore/Drill Rigs	2025	25	50	0.708	0.595	4.004	4.301	0.006	0.194	0.179	599.970	0.024	0.005
Bore/Drill Rigs	2025	50	75	0.357	0.300	4.671	3.327	0.005	0.255	0.235	497.786	0.020	0.004
Bore/Drill Rigs	2025	75	100	0.169	0.142	1.745	3.249	0.005	0.051	0.047	522.567	0.021	0.004
Bore/Drill Rigs	2025	100	175	0.137	0.115	0.900	2.952	0.005	0.040	0.037	530.619	0.022	0.004
Bore/Drill Rigs	2025	175	300	0.135	0.113	1.055	1.055	0.005	0.035	0.032	525.609	0.021	0.004
Bore/Drill Rigs	2025	300	600	0.122	0.102	0.825	0.983	0.005	0.030	0.027	521.059	0.021	0.004
Bore/Drill Rigs	2025	600	750	0.084	0.071	0.417	0.959	0.005	0.016	0.014	530.305	0.022	0.004
Bore/Drill Rigs	2025	750	999	0.205	0.172	3.862	0.994	0.005	0.089	0.082	526.939	0.021	0.004
Bore/Drill Rigs	2026	0	25	1.020	0.843	6.436	3.804	0.011	0.242	0.223	850.895	0.035	0.007
Bore/Drill Rigs	2026	25	50	0.714	0.600	4.008	4.367	0.006	0.190	0.175	604.536	0.025	0.005
Bore/Drill Rigs	2026	50	75	0.367	0.309	4.753	3.379	0.005	0.260	0.239	504.170	0.020	0.004
Bore/Drill Rigs	2026	75	100	0.153	0.128	1.639	3.253	0.005	0.040	0.037	525.082	0.021	0.004
Bore/Drill Rigs	2026	100	175	0.139	0.117	0.888	2.954	0.005	0.040	0.037	529.787	0.021	0.004
Bore/Drill Rigs	2026	175	300	0.139	0.116	1.073	1.061	0.005	0.035	0.032	525.411	0.021	0.004
Bore/Drill Rigs	2026	300	600	0.118	0.099	0.764	0.982	0.005	0.027	0.025	521.126	0.021	0.004
Bore/Drill Rigs	2026	600	750	0.085	0.072	0.417	0.964	0.005	0.016	0.014	531.707	0.022	0.004
Bore/Drill Rigs	2026	750	999	0.208	0.175	3.869	0.998	0.005	0.090	0.083	526.939	0.021	0.004
Bore/Drill Rigs	2027	0	25	1.020	0.843	6.435	3.803	0.011	0.242	0.223	850.656	0.035	0.007
Bore/Drill Rigs	2027	25	50	0.702	0.590	3.852	4.308	0.006	0.175	0.161	600.075	0.024	0.005
Bore/Drill Rigs	2027	50	75	0.165	0.139	2.270	3.209	0.005	0.076	0.070	526.729	0.021	0.004
Bore/Drill Rigs	2027	75	100	0.153	0.129	1.589	3.273	0.005	0.035	0.033	523.974	0.021	0.004
Bore/Drill Rigs	2027	100	175	0.141	0.118	0.859	2.963	0.005	0.041	0.037	530.503	0.022	0.004
Bore/Drill Rigs	2027	175	300	0.136	0.115	1.028	1.060	0.005	0.034	0.032	525.419	0.021	0.004
Bore/Drill Rigs	2027	300	600	0.116	0.098	0.727	0.981	0.005	0.026	0.024	520.885	0.021	0.004
Bore/Drill Rigs	2027	600	750	0.090	0.076	0.424	0.970	0.005	0.016	0.015	531.234	0.022	0.004
Bore/Drill Rigs	2027	750	999	0.211	0.177	3.876	1.001	0.005	0.090	0.083	526.939	0.021	0.004
Bore/Drill Rigs	2028	0	25	1.021	0.844	6.440	3.806	0.011	0.243	0.223	851.416	0.035	0.007
Bore/Drill Rigs	2028	25	50	0.644	0.541	3.750	4.249	0.005	0.156	0.143	595.096	0.024	0.005
Bore/Drill Rigs	2028	50	75	0.196	0.164	2.145	3.237	0.005	0.074	0.068	525.102	0.021	0.004
Bore/Drill Rigs	2028	75	100	0.157	0.132	1.597	3.288	0.005	0.035	0.033	523.638	0.021	0.004
Bore/Drill Rigs	2028	100	175	0.141	0.118	0.854	2.966	0.005	0.040	0.037	529.528	0.021	0.004
Bore/Drill Rigs	2028	175	300	0.134	0.112	1.008	1.051	0.005	0.033	0.030	524.552	0.021	0.004
Bore/Drill Rigs	2028	300	600	0.119	0.100	0.741	0.984	0.005	0.027	0.025	521.095	0.021	0.004
Bore/Drill Rigs	2028	600	750	0.094	0.079	0.428	0.975	0.005	0.016	0.015	530.970	0.022	0.004

Unmitigated EFs from Caleemod 2022 (based on OFFROAD 2017) Appx G, Table G-11

Equipment	Year	Low HP	High HP	TOG	ROG	NOX	CO	SO2	PM10	PM2.5	CO2	CH4	N2O
Bore/Drill Rigs	2028	750	999	0.211	0.177	3.876	1.000	0.005	0.091	0.083	526.939	0.021	0.004
Bore/Drill Rigs	2029	0	25	1.019	0.842	6.431	3.801	0.011	0.242	0.223	850.193	0.034	0.007
Bore/Drill Rigs	2029	25	50	0.688	0.578	3.774	4.319	0.005	0.163	0.150	596.182	0.024	0.005
Bore/Drill Rigs	2029	50	75	0.154	0.129	1.958	3.188	0.005	0.057	0.052	519.600	0.021	0.004
Bore/Drill Rigs	2029	75	100	0.157	0.132	1.580	3.283	0.005	0.034	0.032	523.327	0.021	0.004
Bore/Drill Rigs	2029	100	175	0.137	0.115	0.808	2.954	0.005	0.038	0.035	529.237	0.021	0.004
Bore/Drill Rigs	2029	175	300	0.132	0.111	0.974	1.054	0.005	0.032	0.029	525.142	0.021	0.004
Bore/Drill Rigs	2029	300	600	0.115	0.097	0.703	0.983	0.005	0.026	0.024	522.251	0.021	0.004
Bore/Drill Rigs	2029	600	750	0.097	0.081	0.429	0.979	0.005	0.016	0.015	531.254	0.022	0.004
Bore/Drill Rigs	2029	750	999	0.213	0.179	3.880	1.002	0.005	0.091	0.084	526.939	0.021	0.004
Bore/Drill Rigs	2030	0	25	1.020	0.843	6.433	3.802	0.011	0.242	0.223	850.491	0.034	0.007
Bore/Drill Rigs	2030	25	50	0.633	0.532	3.729	4.254	0.005	0.147	0.135	596.182	0.024	0.005
Bore/Drill Rigs	2030	50	75	0.143	0.120	1.731	3.183	0.005	0.050	0.046	519.600	0.021	0.004
Bore/Drill Rigs	2030	75	100	0.156	0.131	1.576	3.283	0.005	0.033	0.030	523.327	0.021	0.004
Bore/Drill Rigs	2030	100	175	0.135	0.113	0.760	2.954	0.005	0.038	0.035	529.237	0.021	0.004
Bore/Drill Rigs	2030	175	300	0.126	0.106	0.881	1.041	0.005	0.029	0.027	525.275	0.021	0.004
Bore/Drill Rigs	2030	300	600	0.115	0.097	0.685	0.983	0.005	0.026	0.024	522.172	0.021	0.004
Bore/Drill Rigs	2030	600	750	0.096	0.081	0.415	0.979	0.005	0.016	0.015	531.254	0.022	0.004
Bore/Drill Rigs	2030	750	999	0.203	0.171	3.708	1.002	0.005	0.090	0.083	526.939	0.021	0.004
Bore/Drill Rigs	2031	0	25	1.019	0.843	6.432	3.801	0.011	0.242	0.223	850.355	0.034	0.007
Bore/Drill Rigs	2031	25	50	0.580	0.487	3.683	4.206	0.006	0.132	0.121	596.723	0.024	0.005
Bore/Drill Rigs	2031	50	75	0.163	0.137	1.737	3.218	0.005	0.055	0.051	521.591	0.021	0.004
Bore/Drill Rigs	2031	75	100	0.150	0.126	1.541	3.280	0.005	0.029	0.027	523.327	0.021	0.004
Bore/Drill Rigs	2031	100	175	0.132	0.111	0.726	2.949	0.005	0.036	0.033	529.237	0.021	0.004
Bore/Drill Rigs	2031	175	300	0.126	0.106	0.875	1.041	0.005	0.030	0.028	525.142	0.021	0.004
Bore/Drill Rigs	2031	300	600	0.113	0.095	0.635	0.983	0.005	0.024	0.022	522.251	0.021	0.004
Bore/Drill Rigs	2031	600	750	0.096	0.081	0.415	0.979	0.005	0.016	0.015	531.254	0.022	0.004
Bore/Drill Rigs	2031	750	999	0.203	0.171	2.363	1.002	0.005	0.052	0.048	526.939	0.021	0.004
Bore/Drill Rigs	2032	0	25	1.020	0.843	6.435	3.803	0.011	0.242	0.223	850.675	0.035	0.007
Bore/Drill Rigs	2032	25	50	0.577	0.485	3.670	4.189	0.005	0.132	0.122	596.182	0.024	0.005
Bore/Drill Rigs	2032	50	75	0.140	0.118	1.660	3.182	0.005	0.048	0.044	519.600	0.021	0.004
Bore/Drill Rigs	2032	75	100	0.145	0.122	1.517	3.278	0.005	0.025	0.023	523.327	0.021	0.004
Bore/Drill Rigs	2032	100	175	0.128	0.108	0.695	2.949	0.005	0.034	0.031	529.237	0.021	0.004
Bore/Drill Rigs	2032	175	300	0.124	0.104	0.836	1.037	0.005	0.029	0.027	525.142	0.021	0.004
Bore/Drill Rigs	2032	300	600	0.112	0.094	0.618	0.983	0.005	0.023	0.021	522.251	0.021	0.004
Bore/Drill Rigs	2032	600	750	0.092	0.077	0.341	0.979	0.005	0.010	0.009	531.254	0.022	0.004
Bore/Drill Rigs	2032	750	999	0.203	0.171	2.363	1.002	0.005	0.052	0.048	526.939	0.021	0.004
Bore/Drill Rigs	2033	0	25	1.019	0.842	6.431	3.801	0.011	0.242	0.223	850.221	0.034	0.007
Bore/Drill Rigs	2033	25	50	0.546	0.459	3.654	4.153	0.006	0.122	0.112	596.182	0.024	0.005
Bore/Drill Rigs	2033	50	75	0.140	0.118	1.650	3.182	0.005	0.050	0.046	519.600	0.021	0.004
Bore/Drill Rigs	2033	75	100	0.143	0.120	1.507	3.277	0.005	0.024	0.022	523.327	0.021	0.004
Bore/Drill Rigs	2033	100	175	0.123	0.104	0.659	2.948	0.005	0.030	0.028	529.237	0.021	0.004
Bore/Drill Rigs	2033	175	300	0.119	0.100	0.755	1.025	0.005	0.026	0.024	525.142	0.021	0.004
Bore/Drill Rigs	2033	300	600	0.108	0.091	0.549	0.983	0.005	0.018	0.017	522.251	0.021	0.004
Bore/Drill Rigs	2033	600	750	0.092	0.077	0.341	0.979	0.005	0.010	0.009	531.254	0.022	0.004
Bore/Drill Rigs	2033	750	999	0.203	0.171	2.363	1.002	0.005	0.052	0.048	526.939	0.021	0.004
Bore/Drill Rigs	2034	0	25	1.019	0.842	6.429	3.799	0.011	0.242	0.223	849.929	0.034	0.007
Bore/Drill Rigs	2034	25	50	0.511	0.430	3.577	4.107	0.006	0.110	0.101	596.182	0.024	0.005
Bore/Drill Rigs	2034	50	75	0.134	0.113	1.604	3.180	0.005	0.035	0.032	519.600	0.021	0.004
Bore/Drill Rigs	2034	75	100	0.142	0.119	1.500	3.277	0.005	0.023	0.021	523.327	0.021	0.004
Bore/Drill Rigs	2034	100	175	0.121	0.101	0.633	2.947	0.005	0.028	0.025	529.237	0.021	0.004
Bore/Drill Rigs	2034	175	300	0.117	0.099	0.724	1.025	0.005	0.025	0.023	525.142	0.021	0.004
Bore/Drill Rigs	2034	300	600	0.105	0.088	0.488	0.983	0.005	0.014	0.013	522.251	0.021	0.004
Bore/Drill Rigs	2034	600	750	0.092	0.077	0.341	0.979	0.005	0.010	0.009	531.254	0.022	0.004
Bore/Drill Rigs	2034	750	999	0.203	0.171	2.363	1.002	0.005	0.052	0.048	526.939	0.021	0.004
Bore/Drill Rigs	2035	0	25	1.019	0.842	6.429	3.800	0.011	0.242	0.223	849.967	0.034	0.007
Bore/Drill Rigs	2035	25	50	0.466	0.392	3.460	4.070	0.006	0.091	0.084	596.723	0.024	0.005
Bore/Drill Rigs	2035	50	75	0.148	0.124	1.663	3.204	0.005	0.035	0.032	521.591	0.021	0.004
Bore/Drill Rigs	2035	75	100	0.138	0.116	1.461	3.275	0.005	0.020	0.019	523.327	0.021	0.004
Bore/Drill Rigs	2035	100	175	0.119	0.100	0.618	2.947	0.005	0.027	0.025	529.237	0.021	0.004
Bore/Drill Rigs	2035	175	300	0.113	0.095	0.680	1.012	0.005	0.022	0.020	525.142	0.021	0.004
Bore/Drill Rigs	2035	300	600	0.104	0.087	0.467	0.983	0.005	0.014	0.012	522.251	0.021	0.004
Bore/Drill Rigs	2035	600	750	0.088	0.074	0.268	0.979	0.005	0.010	0.009	531.254	0.022	0.004
Bore/Drill Rigs	2035	750	999	0.107	0.090	2.363	1.002	0.005	0.021	0.019	526.939	0.021	0.004
Cement and Mortar Mix	2025	0	25	0.669	0.553	4.200	3.255	0.009	0.164	0.151	570.175	0.023	0.005
Cement and Mortar Mix	2026	0	25	0.669	0.553	4.198	3.255	0.009	0.163	0.150	570.163	0.023	0.005
Cement and Mortar Mix	2027	0	25	0.669	0.553	4.198	3.255	0.009	0.163	0.150	570.320	0.023	0.005

Unmitigated EFs from Caleemod 2022 (based on OFFROAD 2017) Appx G, Table G-11

Equipment	Year	Low HP	High HP	TOG	ROG	NOX	CO	SO2	PM10	PM2.5	CO2	CH4	N2O
Cement and Mortar Mix	2028	0	25	0.669	0.553	4.197	3.256	0.009	0.163	0.150	570.333	0.023	0.005
Cement and Mortar Mix	2029	0	25	0.669	0.553	4.196	3.255	0.009	0.163	0.150	570.219	0.023	0.005
Cement and Mortar Mix	2030	0	25	0.669	0.553	4.195	3.255	0.009	0.163	0.150	570.183	0.023	0.005
Cement and Mortar Mix	2031	0	25	0.669	0.553	4.195	3.255	0.009	0.163	0.150	570.198	0.023	0.005
Cement and Mortar Mix	2032	0	25	0.668	0.552	4.194	3.254	0.009	0.162	0.149	570.106	0.023	0.005
Cement and Mortar Mix	2033	0	25	0.668	0.552	4.194	3.254	0.009	0.162	0.149	570.131	0.023	0.005
Cement and Mortar Mix	2034	0	25	0.669	0.553	4.195	3.255	0.009	0.162	0.149	570.201	0.023	0.005
Cement and Mortar Mix	2035	0	25	0.668	0.552	4.193	3.254	0.009	0.162	0.149	569.993	0.023	0.005
Concrete/Industrial Saw	2025	0	25	0.719	0.595	4.546	2.456	0.008	0.170	0.156	596.388	0.024	0.005
Concrete/Industrial Saw	2025	25	50	0.532	0.439	3.635	4.348	0.007	0.101	0.093	575.013	0.023	0.005
Concrete/Industrial Saw	2026	0	25	0.717	0.593	4.532	2.448	0.008	0.169	0.156	594.535	0.024	0.005
Concrete/Industrial Saw	2026	25	50	0.499	0.413	3.526	4.315	0.007	0.085	0.078	574.357	0.023	0.005
Concrete/Industrial Saw	2027	0	25	0.714	0.590	4.509	2.435	0.008	0.168	0.155	591.493	0.024	0.005
Concrete/Industrial Saw	2027	25	50	0.472	0.390	3.430	4.291	0.007	0.071	0.065	574.332	0.023	0.005
Concrete/Industrial Saw	2028	0	25	0.711	0.587	4.491	2.426	0.007	0.168	0.154	589.166	0.024	0.005
Concrete/Industrial Saw	2028	25	50	0.448	0.370	3.344	4.271	0.007	0.058	0.053	574.375	0.023	0.005
Concrete/Industrial Saw	2029	0	25	0.708	0.585	4.474	2.417	0.007	0.167	0.154	586.916	0.024	0.005
Concrete/Industrial Saw	2029	25	50	0.429	0.355	3.293	4.257	0.007	0.049	0.045	574.485	0.023	0.005
Concrete/Industrial Saw	2030	0	25	0.710	0.587	4.485	2.422	0.007	0.168	0.154	588.267	0.024	0.005
Concrete/Industrial Saw	2030	25	50	0.414	0.342	3.255	4.241	0.007	0.042	0.039	574.000	0.023	0.005
Concrete/Industrial Saw	2031	0	25	0.711	0.587	4.490	2.425	0.007	0.168	0.154	589.005	0.024	0.005
Concrete/Industrial Saw	2031	25	50	0.402	0.332	3.221	4.227	0.007	0.036	0.033	573.268	0.023	0.005
Concrete/Industrial Saw	2032	0	25	0.708	0.585	4.474	2.416	0.007	0.167	0.154	586.839	0.024	0.005
Concrete/Industrial Saw	2032	25	50	0.393	0.325	3.197	4.224	0.007	0.031	0.029	573.771	0.023	0.005
Concrete/Industrial Saw	2033	0	25	0.706	0.584	4.462	2.410	0.007	0.167	0.153	585.302	0.024	0.005
Concrete/Industrial Saw	2033	25	50	0.386	0.319	3.175	4.221	0.007	0.027	0.025	573.945	0.023	0.005
Concrete/Industrial Saw	2034	0	25	0.708	0.585	4.472	2.415	0.007	0.167	0.154	586.602	0.024	0.005
Concrete/Industrial Saw	2034	25	50	0.382	0.315	3.154	4.216	0.007	0.024	0.022	573.677	0.023	0.005
Concrete/Industrial Saw	2035	0	25	0.707	0.584	4.469	2.414	0.007	0.167	0.154	586.211	0.024	0.005
Concrete/Industrial Saw	2035	25	50	0.379	0.313	3.137	4.215	0.007	0.021	0.020	573.725	0.023	0.005
Cranes	2025	0	25	1.509	1.268	4.898	5.859	0.005	0.389	0.358	586.607	0.024	0.005
Cranes	2025	25	50	2.245	1.886	5.810	7.309	0.005	0.565	0.520	592.060	0.024	0.005
Cranes	2025	50	75	1.636	1.375	9.722	4.696	0.005	0.981	0.903	525.413	0.021	0.004
Cranes	2025	75	100	0.456	0.383	3.564	3.727	0.005	0.206	0.190	526.436	0.021	0.004
Cranes	2025	100	175	0.424	0.356	3.321	3.362	0.005	0.181	0.166	528.683	0.021	0.004
Cranes	2025	175	300	0.322	0.270	2.772	1.537	0.005	0.118	0.108	527.564	0.021	0.004
Cranes	2025	300	600	0.239	0.201	1.950	1.663	0.005	0.079	0.073	527.585	0.021	0.004
Cranes	2025	600	750	0.452	0.380	3.764	2.675	0.005	0.187	0.172	527.208	0.021	0.004
Cranes	2025	750	999	0.579	0.487	6.034	4.087	0.005	0.251	0.231	527.447	0.021	0.004
Cranes	2026	0	25	1.548	1.301	4.933	5.994	0.005	0.396	0.364	586.607	0.024	0.005
Cranes	2026	25	50	1.747	1.468	5.170	6.409	0.005	0.440	0.405	589.414	0.024	0.005
Cranes	2026	50	75	1.643	1.381	9.744	4.710	0.005	0.988	0.909	525.501	0.021	0.004
Cranes	2026	75	100	0.428	0.360	3.353	3.706	0.005	0.188	0.173	526.523	0.021	0.004
Cranes	2026	100	175	0.385	0.323	2.937	3.329	0.005	0.158	0.146	528.820	0.021	0.004
Cranes	2026	175	300	0.297	0.250	2.511	1.484	0.005	0.104	0.096	527.563	0.021	0.004
Cranes	2026	300	600	0.235	0.198	1.837	1.637	0.005	0.075	0.069	527.461	0.021	0.004
Cranes	2026	600	750	0.477	0.400	4.284	2.686	0.005	0.196	0.180	527.258	0.021	0.004
Cranes	2026	750	999	0.478	0.402	5.250	3.301	0.005	0.201	0.185	527.133	0.021	0.004
Cranes	2027	0	25	1.587	1.334	4.967	6.129	0.005	0.403	0.370	586.607	0.024	0.005
Cranes	2027	25	50	1.273	1.070	4.674	5.648	0.005	0.330	0.304	587.468	0.024	0.005
Cranes	2027	50	75	1.651	1.388	9.683	4.728	0.005	0.996	0.917	525.346	0.021	0.004
Cranes	2027	75	100	0.401	0.337	3.190	3.700	0.005	0.165	0.152	527.003	0.021	0.004
Cranes	2027	100	175	0.358	0.301	2.680	3.311	0.005	0.143	0.131	528.803	0.021	0.004
Cranes	2027	175	300	0.278	0.234	2.251	1.446	0.005	0.094	0.086	527.560	0.021	0.004
Cranes	2027	300	600	0.232	0.195	1.748	1.629	0.005	0.072	0.066	527.455	0.021	0.004
Cranes	2027	600	750	0.323	0.271	2.535	2.233	0.005	0.126	0.116	527.099	0.021	0.004
Cranes	2027	750	999	0.488	0.410	5.298	3.339	0.005	0.204	0.187	527.522	0.021	0.004
Cranes	2028	0	25	1.616	1.358	4.996	6.242	0.005	0.407	0.375	586.607	0.024	0.005
Cranes	2028	25	50	1.295	1.088	4.705	5.757	0.005	0.334	0.307	587.606	0.024	0.005
Cranes	2028	50	75	1.655	1.391	9.683	4.735	0.005	1.000	0.920	525.358	0.021	0.004
Cranes	2028	75	100	0.389	0.327	3.070	3.702	0.005	0.156	0.143	527.416	0.021	0.004
Cranes	2028	100	175	0.348	0.292	2.554	3.315	0.005	0.135	0.124	528.690	0.021	0.004
Cranes	2028	175	300	0.269	0.226	2.103	1.416	0.005	0.088	0.081	527.543	0.021	0.004
Cranes	2028	300	600	0.223	0.187	1.601	1.628	0.005	0.066	0.061	527.754	0.021	0.004
Cranes	2028	600	750	0.333	0.280	2.558	1.836	0.005	0.127	0.117	527.440	0.021	0.004
Cranes	2028	750	999	0.480	0.403	5.321	3.360	0.005	0.202	0.186	527.094	0.021	0.004

Unmitigated EFs from Caleemod 2022 (based on OFFROAD 2017) Appx G, Table G-11

Equipment	Year	Low HP	High HP	TOG	ROG	NOX	CO	SO2	PM10	PM2.5	CO2	CH4	N2O
Cranes	2029	0	25	1.627	1.367	5.016	6.314	0.005	0.409	0.376	586.607	0.024	0.005
Cranes	2029	25	50	1.165	0.979	4.575	5.560	0.005	0.304	0.280	587.686	0.024	0.005
Cranes	2029	50	75	1.658	1.393	9.695	4.743	0.005	1.003	0.922	525.599	0.021	0.004
Cranes	2029	75	100	0.392	0.329	3.023	3.718	0.005	0.159	0.146	527.548	0.021	0.004
Cranes	2029	100	175	0.343	0.288	2.474	3.332	0.005	0.129	0.118	528.595	0.021	0.004
Cranes	2029	175	300	0.267	0.225	2.039	1.411	0.005	0.086	0.079	527.578	0.021	0.004
Cranes	2029	300	600	0.216	0.182	1.484	1.606	0.005	0.062	0.057	527.611	0.021	0.004
Cranes	2029	600	750	0.330	0.277	2.554	2.551	0.005	0.127	0.117	527.646	0.021	0.004
Cranes	2029	750	999	0.358	0.300	4.340	2.557	0.005	0.143	0.132	527.217	0.021	0.004
Cranes	2030	0	25	1.627	1.367	5.016	6.314	0.005	0.409	0.376	586.607	0.024	0.005
Cranes	2030	25	50	1.058	0.889	4.524	5.423	0.005	0.281	0.258	587.686	0.024	0.005
Cranes	2030	50	75	1.549	1.301	9.409	4.690	0.005	0.933	0.859	525.599	0.021	0.004
Cranes	2030	75	100	0.388	0.326	2.975	3.712	0.005	0.150	0.138	527.548	0.021	0.004
Cranes	2030	100	175	0.324	0.273	2.272	3.322	0.005	0.122	0.113	528.595	0.021	0.004
Cranes	2030	175	300	0.255	0.215	1.888	1.343	0.005	0.080	0.074	527.578	0.021	0.004
Cranes	2030	300	600	0.211	0.178	1.430	1.604	0.005	0.061	0.056	527.611	0.021	0.004
Cranes	2030	600	750	0.313	0.263	2.491	2.551	0.005	0.120	0.110	527.646	0.021	0.004
Cranes	2030	750	999	0.317	0.266	4.191	2.557	0.005	0.126	0.115	527.217	0.021	0.004
Cranes	2031	0	25	1.627	1.367	4.336	6.314	0.005	0.343	0.315	586.607	0.024	0.005
Cranes	2031	25	50	1.019	0.856	4.517	5.385	0.005	0.265	0.244	587.686	0.024	0.005
Cranes	2031	50	75	1.512	1.270	9.314	4.671	0.005	0.910	0.837	525.599	0.021	0.004
Cranes	2031	75	100	0.375	0.315	2.817	3.695	0.005	0.144	0.132	527.548	0.021	0.004
Cranes	2031	100	175	0.313	0.263	2.144	3.314	0.005	0.118	0.108	528.595	0.021	0.004
Cranes	2031	175	300	0.249	0.209	1.784	1.335	0.005	0.077	0.071	527.578	0.021	0.004
Cranes	2031	300	600	0.207	0.174	1.347	1.588	0.005	0.059	0.054	527.611	0.021	0.004
Cranes	2031	600	750	0.302	0.254	2.367	2.551	0.005	0.107	0.099	527.646	0.021	0.004
Cranes	2031	750	999	0.306	0.257	4.058	2.557	0.005	0.119	0.109	527.217	0.021	0.004
Cranes	2032	0	25	0.936	0.787	4.143	5.646	0.005	0.250	0.230	586.607	0.024	0.005
Cranes	2032	25	50	1.007	0.846	4.443	5.373	0.005	0.253	0.232	587.686	0.024	0.005
Cranes	2032	50	75	1.493	1.255	9.266	4.661	0.005	0.899	0.827	525.599	0.021	0.004
Cranes	2032	75	100	0.373	0.313	2.777	3.695	0.005	0.141	0.130	527.548	0.021	0.004
Cranes	2032	100	175	0.300	0.252	2.011	3.306	0.005	0.110	0.102	528.595	0.021	0.004
Cranes	2032	175	300	0.242	0.203	1.680	1.323	0.005	0.072	0.066	527.578	0.021	0.004
Cranes	2032	300	600	0.199	0.168	1.257	1.558	0.005	0.053	0.049	527.611	0.021	0.004
Cranes	2032	600	750	0.294	0.247	2.305	2.551	0.005	0.101	0.093	527.646	0.021	0.004
Cranes	2032	750	999	0.288	0.242	3.929	2.557	0.005	0.105	0.097	527.217	0.021	0.004
Cranes	2033	0	25	0.706	0.594	4.106	5.424	0.005	0.220	0.203	586.607	0.024	0.005
Cranes	2033	25	50	0.994	0.835	4.195	5.361	0.005	0.217	0.200	587.686	0.024	0.005
Cranes	2033	50	75	1.493	1.255	9.266	4.661	0.005	0.899	0.827	525.599	0.021	0.004
Cranes	2033	75	100	0.358	0.301	2.684	3.679	0.005	0.129	0.119	527.548	0.021	0.004
Cranes	2033	100	175	0.293	0.246	1.946	3.301	0.005	0.105	0.097	528.595	0.021	0.004
Cranes	2033	175	300	0.235	0.197	1.587	1.313	0.005	0.068	0.062	527.578	0.021	0.004
Cranes	2033	300	600	0.194	0.163	1.183	1.556	0.005	0.047	0.043	527.611	0.021	0.004
Cranes	2033	600	750	0.294	0.247	2.305	2.551	0.005	0.101	0.093	527.646	0.021	0.004
Cranes	2033	750	999	0.288	0.242	3.929	2.557	0.005	0.105	0.097	527.217	0.021	0.004
Cranes	2034	0	25	0.593	0.498	4.089	5.309	0.005	0.205	0.188	586.607	0.024	0.005
Cranes	2034	25	50	0.919	0.772	4.046	5.241	0.005	0.195	0.179	587.686	0.024	0.005
Cranes	2034	50	75	1.189	0.999	8.141	4.515	0.005	0.698	0.643	525.599	0.021	0.004
Cranes	2034	75	100	0.355	0.298	2.655	3.678	0.005	0.125	0.115	527.548	0.021	0.004
Cranes	2034	100	175	0.282	0.237	1.862	3.297	0.005	0.098	0.090	528.595	0.021	0.004
Cranes	2034	175	300	0.228	0.192	1.499	1.294	0.005	0.064	0.059	527.578	0.021	0.004
Cranes	2034	300	600	0.189	0.159	1.130	1.552	0.005	0.044	0.041	527.611	0.021	0.004
Cranes	2034	600	750	0.285	0.240	2.182	2.551	0.005	0.101	0.093	527.646	0.021	0.004
Cranes	2034	750	999	0.287	0.241	3.840	2.557	0.005	0.103	0.095	527.217	0.021	0.004
Cranes	2035	0	25	0.593	0.498	4.089	5.309	0.005	0.205	0.188	586.607	0.024	0.005
Cranes	2035	25	50	0.854	0.717	3.943	5.178	0.005	0.177	0.163	587.686	0.024	0.005
Cranes	2035	50	75	1.092	0.918	7.892	4.467	0.005	0.638	0.587	525.599	0.021	0.004
Cranes	2035	75	100	0.344	0.289	2.606	3.673	0.005	0.115	0.106	527.548	0.021	0.004
Cranes	2035	100	175	0.273	0.230	1.775	3.292	0.005	0.092	0.085	528.595	0.021	0.004
Cranes	2035	175	300	0.220	0.185	1.409	1.278	0.005	0.060	0.055	527.578	0.021	0.004
Cranes	2035	300	600	0.184	0.155	1.054	1.506	0.005	0.043	0.039	527.611	0.021	0.004
Cranes	2035	600	750	0.294	0.247	2.178	2.411	0.005	0.105	0.096	527.636	0.021	0.004
Cranes	2035	750	999	0.279	0.235	3.810	2.557	0.005	0.099	0.091	527.217	0.021	0.004
Crawler Tractors	2025	25	50	2.095	1.761	4.984	6.752	0.005	0.461	0.424	582.954	0.024	0.005
Crawler Tractors	2025	50	75	2.321	1.950	15.444	6.322	0.005	1.132	1.042	527.857	0.021	0.004
Crawler Tractors	2025	75	100	0.528	0.443	3.876	3.747	0.005	0.279	0.256	528.471	0.021	0.004
Crawler Tractors	2025	100	175	0.356	0.299	2.697	3.211	0.005	0.151	0.139	527.479	0.021	0.004

Unmitigated EFs from Caleemod 2022 (based on OFFROAD 2017) Appx G, Table G-11

Equipment	Year	Low HP	High HP	TOG	ROG	NOX	CO	SO2	PM10	PM2.5	CO2	CH4	N2O
Crawler Tractors	2025	175	300	0.330	0.277	2.934	1.749	0.005	0.122	0.113	527.288	0.021	0.004
Crawler Tractors	2025	300	600	0.215	0.180	1.630	1.417	0.005	0.065	0.060	528.093	0.021	0.004
Crawler Tractors	2025	600	750	0.488	0.410	5.326	1.929	0.005	0.178	0.164	524.386	0.021	0.004
Crawler Tractors	2025	750	999	0.265	0.223	4.257	1.396	0.005	0.095	0.088	533.878	0.022	0.004
Crawler Tractors	2026	25	50	1.939	1.629	4.805	6.521	0.005	0.418	0.384	584.823	0.024	0.005
Crawler Tractors	2026	50	75	0.848	0.712	6.262	4.545	0.005	0.458	0.421	544.396	0.022	0.004
Crawler Tractors	2026	75	100	0.492	0.414	3.631	3.725	0.005	0.251	0.231	528.629	0.021	0.004
Crawler Tractors	2026	100	175	0.331	0.278	2.442	3.207	0.005	0.136	0.125	527.281	0.021	0.004
Crawler Tractors	2026	175	300	0.316	0.265	2.724	1.707	0.005	0.115	0.105	527.271	0.021	0.004
Crawler Tractors	2026	300	600	0.207	0.174	1.487	1.412	0.005	0.060	0.055	528.096	0.021	0.004
Crawler Tractors	2026	600	750	0.306	0.257	2.994	1.597	0.005	0.100	0.092	524.705	0.021	0.004
Crawler Tractors	2026	750	999	0.269	0.226	4.261	1.404	0.005	0.096	0.088	534.142	0.022	0.004
Crawler Tractors	2027	25	50	1.876	1.577	4.717	6.414	0.005	0.398	0.366	585.693	0.024	0.005
Crawler Tractors	2027	50	75	1.083	0.910	7.701	4.838	0.005	0.564	0.519	541.522	0.022	0.004
Crawler Tractors	2027	75	100	0.443	0.372	3.310	3.690	0.005	0.215	0.198	529.009	0.021	0.004
Crawler Tractors	2027	100	175	0.308	0.259	2.194	3.205	0.005	0.121	0.111	526.909	0.021	0.004
Crawler Tractors	2027	175	300	0.266	0.224	2.189	1.397	0.005	0.089	0.082	527.027	0.021	0.004
Crawler Tractors	2027	300	600	0.211	0.178	1.467	1.476	0.005	0.060	0.055	528.139	0.021	0.004
Crawler Tractors	2027	600	750	0.342	0.287	3.619	1.807	0.005	0.134	0.123	527.515	0.021	0.004
Crawler Tractors	2027	750	999	0.240	0.201	3.857	1.397	0.005	0.081	0.075	534.444	0.022	0.004
Crawler Tractors	2028	25	50	1.748	1.469	4.583	6.255	0.005	0.366	0.337	584.591	0.024	0.005
Crawler Tractors	2028	50	75	1.155	0.971	8.062	4.821	0.005	0.614	0.565	539.998	0.022	0.004
Crawler Tractors	2028	75	100	0.405	0.340	3.059	3.669	0.005	0.186	0.171	528.574	0.021	0.004
Crawler Tractors	2028	100	175	0.292	0.245	2.013	3.207	0.005	0.111	0.102	526.884	0.021	0.004
Crawler Tractors	2028	175	300	0.261	0.219	2.050	1.404	0.005	0.085	0.078	527.365	0.021	0.004
Crawler Tractors	2028	300	600	0.202	0.170	1.334	1.457	0.005	0.055	0.050	528.225	0.021	0.004
Crawler Tractors	2028	600	750	0.353	0.297	3.696	1.830	0.005	0.137	0.126	526.000	0.021	0.004
Crawler Tractors	2028	750	999	0.231	0.194	3.740	1.364	0.005	0.076	0.070	534.732	0.022	0.004
Crawler Tractors	2029	25	50	1.599	1.344	4.430	6.031	0.005	0.329	0.303	583.759	0.024	0.005
Crawler Tractors	2029	50	75	1.022	0.858	7.183	4.654	0.005	0.556	0.511	542.952	0.022	0.004
Crawler Tractors	2029	75	100	0.385	0.324	2.919	3.670	0.005	0.168	0.154	528.992	0.021	0.004
Crawler Tractors	2029	100	175	0.282	0.237	1.868	3.214	0.005	0.105	0.096	526.938	0.021	0.004
Crawler Tractors	2029	175	300	0.249	0.210	1.858	1.392	0.005	0.078	0.072	527.287	0.021	0.004
Crawler Tractors	2029	300	600	0.199	0.168	1.258	1.448	0.005	0.052	0.048	528.108	0.021	0.004
Crawler Tractors	2029	600	750	0.325	0.273	3.296	1.733	0.005	0.123	0.113	526.670	0.021	0.004
Crawler Tractors	2029	750	999	0.232	0.195	3.734	1.369	0.005	0.076	0.070	535.359	0.022	0.004
Crawler Tractors	2030	25	50	1.581	1.329	4.413	6.014	0.005	0.321	0.296	583.759	0.024	0.005
Crawler Tractors	2030	50	75	1.022	0.858	7.183	4.654	0.005	0.556	0.511	542.952	0.022	0.004
Crawler Tractors	2030	75	100	0.365	0.306	2.812	3.657	0.005	0.155	0.143	528.992	0.021	0.004
Crawler Tractors	2030	100	175	0.269	0.226	1.758	3.210	0.005	0.099	0.091	526.938	0.021	0.004
Crawler Tractors	2030	175	300	0.240	0.202	1.719	1.381	0.005	0.074	0.068	527.287	0.021	0.004
Crawler Tractors	2030	300	600	0.194	0.163	1.182	1.428	0.005	0.050	0.046	528.108	0.021	0.004
Crawler Tractors	2030	600	750	0.321	0.270	3.193	1.733	0.005	0.120	0.111	526.670	0.021	0.004
Crawler Tractors	2030	750	999	0.228	0.191	3.593	1.369	0.005	0.073	0.067	535.359	0.022	0.004
Crawler Tractors	2031	25	50	1.577	1.325	4.399	6.011	0.005	0.320	0.294	583.759	0.024	0.005
Crawler Tractors	2031	50	75	1.022	0.858	7.183	4.654	0.005	0.565	0.520	542.952	0.022	0.004
Crawler Tractors	2031	75	100	0.354	0.297	2.720	3.646	0.005	0.148	0.136	528.992	0.021	0.004
Crawler Tractors	2031	100	175	0.257	0.216	1.646	3.202	0.005	0.092	0.085	526.938	0.021	0.004
Crawler Tractors	2031	175	300	0.236	0.198	1.636	1.375	0.005	0.072	0.066	527.287	0.021	0.004
Crawler Tractors	2031	300	600	0.191	0.161	1.113	1.397	0.005	0.048	0.045	528.108	0.021	0.004
Crawler Tractors	2031	600	750	0.318	0.267	3.101	1.733	0.005	0.120	0.110	526.670	0.021	0.004
Crawler Tractors	2031	750	999	0.216	0.181	3.446	1.315	0.005	0.068	0.063	535.359	0.022	0.004
Crawler Tractors	2032	25	50	1.543	1.297	4.380	5.978	0.005	0.314	0.289	583.759	0.024	0.005
Crawler Tractors	2032	50	75	1.002	0.842	6.940	4.654	0.005	0.471	0.434	542.952	0.022	0.004
Crawler Tractors	2032	75	100	0.342	0.287	2.587	3.639	0.005	0.141	0.129	528.992	0.021	0.004
Crawler Tractors	2032	100	175	0.249	0.210	1.559	3.200	0.005	0.087	0.080	526.938	0.021	0.004
Crawler Tractors	2032	175	300	0.230	0.193	1.525	1.368	0.005	0.067	0.062	527.287	0.021	0.004
Crawler Tractors	2032	300	600	0.187	0.157	1.060	1.373	0.005	0.045	0.042	528.108	0.021	0.004
Crawler Tractors	2032	600	750	0.318	0.267	3.101	1.733	0.005	0.120	0.110	526.670	0.021	0.004
Crawler Tractors	2032	750	999	0.215	0.181	3.415	1.315	0.005	0.068	0.063	535.359	0.022	0.004
Crawler Tractors	2033	25	50	1.533	1.288	4.357	5.968	0.005	0.311	0.286	583.759	0.024	0.005
Crawler Tractors	2033	50	75	1.002	0.842	6.940	4.654	0.005	0.471	0.434	542.952	0.022	0.004
Crawler Tractors	2033	75	100	0.330	0.277	2.492	3.632	0.005	0.131	0.120	528.992	0.021	0.004
Crawler Tractors	2033	100	175	0.241	0.202	1.478	3.197	0.005	0.082	0.076	526.938	0.021	0.004
Crawler Tractors	2033	175	300	0.224	0.188	1.455	1.355	0.005	0.063	0.058	527.287	0.021	0.004
Crawler Tractors	2033	300	600	0.184	0.155	1.015	1.357	0.005	0.043	0.039	528.108	0.021	0.004
Crawler Tractors	2033	600	750	0.317	0.267	2.704	1.733	0.005	0.120	0.110	526.670	0.021	0.004
Crawler Tractors	2033	750	999	0.206	0.173	3.345	1.261	0.005	0.065	0.060	535.359	0.022	0.004

Unmitigated EFs from Caleemod 2022 (based on OFFROAD 2017) Appx G, Table G-11

Equipment	Year	Low HP	High HP	TOG	ROG	NOX	CO	SO2	PM10	PM2.5	CO2	CH4	N2O
Crawler Tractors	2034	25	50	1.520	1.277	4.348	5.949	0.005	0.308	0.283	583.759	0.024	0.005
Crawler Tractors	2034	50	75	0.988	0.830	6.839	4.619	0.005	0.417	0.383	542.952	0.022	0.004
Crawler Tractors	2034	75	100	0.319	0.268	2.427	3.627	0.005	0.123	0.113	528.992	0.021	0.004
Crawler Tractors	2034	100	175	0.231	0.194	1.402	3.193	0.005	0.076	0.070	526.938	0.021	0.004
Crawler Tractors	2034	175	300	0.218	0.183	1.384	1.351	0.005	0.059	0.054	527.287	0.021	0.004
Crawler Tractors	2034	300	600	0.180	0.151	0.961	1.342	0.005	0.039	0.036	528.108	0.021	0.004
Crawler Tractors	2034	600	750	0.259	0.218	2.353	1.503	0.005	0.090	0.083	526.670	0.021	0.004
Crawler Tractors	2034	750	999	0.202	0.169	3.264	1.261	0.005	0.063	0.058	535.359	0.022	0.004
Crawler Tractors	2035	25	50	1.520	1.277	4.306	5.949	0.005	0.303	0.279	583.759	0.024	0.005
Crawler Tractors	2035	50	75	0.936	0.787	6.064	4.619	0.005	0.417	0.383	542.952	0.022	0.004
Crawler Tractors	2035	75	100	0.307	0.258	2.386	3.621	0.005	0.113	0.104	528.992	0.021	0.004
Crawler Tractors	2035	100	175	0.224	0.188	1.327	3.192	0.005	0.071	0.066	526.938	0.021	0.004
Crawler Tractors	2035	175	300	0.213	0.179	1.314	1.347	0.005	0.055	0.051	527.287	0.021	0.004
Crawler Tractors	2035	300	600	0.175	0.147	0.909	1.329	0.005	0.036	0.033	528.108	0.021	0.004
Crawler Tractors	2035	600	750	0.257	0.216	2.306	1.503	0.005	0.089	0.082	526.670	0.021	0.004
Crawler Tractors	2035	750	999	0.197	0.166	3.078	1.257	0.005	0.057	0.053	535.359	0.022	0.004
Dumpers/Tenders	2025	0	25	0.691	0.571	4.367	2.359	0.007	0.163	0.150	572.880	0.023	0.005
Dumpers/Tenders	2026	0	25	0.690	0.570	4.358	2.354	0.007	0.163	0.150	571.605	0.023	0.005
Dumpers/Tenders	2027	0	25	0.690	0.570	4.361	2.355	0.007	0.163	0.150	572.007	0.023	0.005
Dumpers/Tenders	2028	0	25	0.690	0.571	4.362	2.356	0.007	0.163	0.150	572.228	0.023	0.005
Dumpers/Tenders	2029	0	25	0.690	0.570	4.358	2.354	0.007	0.163	0.150	571.601	0.023	0.005
Dumpers/Tenders	2030	0	25	0.690	0.571	4.362	2.356	0.007	0.163	0.150	572.239	0.023	0.005
Dumpers/Tenders	2031	0	25	0.690	0.570	4.360	2.355	0.007	0.163	0.150	571.956	0.023	0.005
Dumpers/Tenders	2032	0	25	0.690	0.570	4.358	2.354	0.007	0.163	0.150	571.680	0.023	0.005
Dumpers/Tenders	2033	0	25	0.690	0.571	4.363	2.356	0.007	0.163	0.150	572.294	0.023	0.005
Dumpers/Tenders	2034	0	25	0.690	0.570	4.359	2.354	0.007	0.163	0.150	571.782	0.023	0.005
Dumpers/Tenders	2035	0	25	0.689	0.570	4.356	2.353	0.007	0.163	0.150	571.360	0.023	0.005
Excavators	2025	0	25	1.066	0.882	6.484	3.582	0.011	0.251	0.231	845.980	0.034	0.007
Excavators	2025	25	50	0.478	0.402	3.446	4.211	0.005	0.107	0.098	587.138	0.024	0.005
Excavators	2025	50	75	0.267	0.224	2.514	3.342	0.005	0.139	0.128	527.223	0.021	0.004
Excavators	2025	75	100	0.235	0.197	2.045	3.460	0.005	0.081	0.074	524.872	0.021	0.004
Excavators	2025	100	175	0.189	0.159	1.164	3.078	0.005	0.057	0.053	528.086	0.021	0.004
Excavators	2025	175	300	0.158	0.133	0.987	1.099	0.005	0.033	0.030	528.274	0.021	0.004
Excavators	2025	300	600	0.137	0.115	0.714	1.043	0.005	0.025	0.023	526.988	0.021	0.004
Excavators	2025	600	750	0.260	0.218	2.427	1.510	0.005	0.089	0.082	530.428	0.022	0.004
Excavators	2025	750	999	0.094	0.079	2.360	0.992	0.005	0.021	0.020	534.921	0.022	0.004
Excavators	2026	0	25	1.067	0.883	6.484	3.584	0.011	0.251	0.231	845.883	0.034	0.007
Excavators	2026	25	50	0.468	0.393	3.407	4.221	0.005	0.099	0.091	587.029	0.024	0.005
Excavators	2026	50	75	0.866	0.727	5.350	4.195	0.005	0.554	0.509	533.887	0.022	0.004
Excavators	2026	75	100	0.217	0.182	1.930	3.447	0.005	0.066	0.061	525.128	0.021	0.004
Excavators	2026	100	175	0.175	0.147	1.010	3.071	0.005	0.049	0.045	527.886	0.021	0.004
Excavators	2026	175	300	0.155	0.130	0.918	1.099	0.005	0.031	0.029	528.178	0.021	0.004
Excavators	2026	300	600	0.136	0.114	0.681	1.045	0.005	0.024	0.022	527.153	0.021	0.004
Excavators	2026	600	750	0.195	0.164	1.421	1.287	0.005	0.050	0.046	530.733	0.022	0.004
Excavators	2026	750	999	0.101	0.085	2.375	1.001	0.005	0.022	0.020	534.915	0.022	0.004
Excavators	2027	0	25	1.068	0.884	6.485	3.587	0.011	0.252	0.231	845.880	0.034	0.007
Excavators	2027	25	50	0.450	0.378	3.367	4.216	0.005	0.089	0.082	587.394	0.024	0.005
Excavators	2027	50	75	0.823	0.691	5.184	4.211	0.005	0.523	0.481	538.243	0.022	0.004
Excavators	2027	75	100	0.206	0.173	1.844	3.445	0.005	0.057	0.052	525.122	0.021	0.004
Excavators	2027	100	175	0.169	0.142	0.924	3.078	0.005	0.045	0.041	528.003	0.021	0.004
Excavators	2027	175	300	0.150	0.126	0.829	1.098	0.005	0.028	0.026	528.164	0.021	0.004
Excavators	2027	300	600	0.133	0.112	0.620	1.041	0.005	0.022	0.020	527.012	0.021	0.004
Excavators	2027	600	750	0.201	0.169	1.427	1.296	0.005	0.051	0.047	530.615	0.022	0.004
Excavators	2027	750	999	0.109	0.091	2.393	1.013	0.005	0.022	0.020	534.832	0.022	0.004
Excavators	2028	0	25	1.069	0.885	6.484	3.589	0.011	0.252	0.232	845.602	0.034	0.007
Excavators	2028	25	50	0.436	0.366	3.339	4.222	0.005	0.081	0.075	587.541	0.024	0.005
Excavators	2028	50	75	0.897	0.754	5.454	4.206	0.005	0.570	0.525	529.773	0.021	0.004
Excavators	2028	75	100	0.198	0.166	1.761	3.448	0.005	0.048	0.044	525.155	0.021	0.004
Excavators	2028	100	175	0.163	0.137	0.837	3.087	0.005	0.040	0.037	528.134	0.021	0.004
Excavators	2028	175	300	0.148	0.124	0.759	1.099	0.005	0.027	0.025	528.129	0.021	0.004
Excavators	2028	300	600	0.130	0.110	0.579	1.040	0.005	0.021	0.019	527.040	0.021	0.004
Excavators	2028	600	750	0.221	0.186	1.681	1.353	0.005	0.060	0.055	528.785	0.021	0.004
Excavators	2028	750	999	0.109	0.091	2.392	1.013	0.005	0.022	0.020	534.724	0.022	0.004
Excavators	2029	0	25	1.043	0.862	6.476	3.534	0.011	0.246	0.226	847.414	0.034	0.007
Excavators	2029	25	50	0.425	0.357	3.312	4.225	0.005	0.074	0.068	588.066	0.024	0.005
Excavators	2029	50	75	1.593	1.339	8.554	4.589	0.005	1.021	0.940	527.007	0.021	0.004
Excavators	2029	75	100	0.193	0.162	1.704	3.447	0.005	0.043	0.039	524.860	0.021	0.004

Unmitigated EFs from Caleemod 2022 (based on OFFROAD 2017) Appx G, Table G-11

Equipment	Year	Low HP	High HP	TOG	ROG	NOX	CO	SO2	PM10	PM2.5	CO2	CH4	N2O
Excavators	2029	100	175	0.161	0.135	0.790	3.094	0.005	0.038	0.035	528.144	0.021	0.004
Excavators	2029	175	300	0.147	0.124	0.729	1.102	0.005	0.026	0.024	528.080	0.021	0.004
Excavators	2029	300	600	0.129	0.108	0.549	1.041	0.005	0.020	0.018	527.304	0.021	0.004
Excavators	2029	600	750	0.233	0.196	1.786	1.386	0.005	0.064	0.059	531.157	0.022	0.004
Excavators	2029	750	999	0.093	0.078	2.329	0.979	0.005	0.021	0.019	528.437	0.021	0.004
Excavators	2030	0	25	1.043	0.862	6.476	3.534	0.011	0.246	0.226	847.402	0.034	0.007
Excavators	2030	25	50	0.390	0.328	3.297	4.190	0.005	0.066	0.061	588.066	0.024	0.005
Excavators	2030	50	75	1.593	1.339	8.554	4.589	0.005	1.021	0.940	527.007	0.021	0.004
Excavators	2030	75	100	0.187	0.157	1.663	3.444	0.005	0.038	0.035	524.860	0.021	0.004
Excavators	2030	100	175	0.157	0.132	0.733	3.092	0.005	0.036	0.033	528.144	0.021	0.004
Excavators	2030	175	300	0.144	0.121	0.680	1.099	0.005	0.025	0.023	528.080	0.021	0.004
Excavators	2030	300	600	0.127	0.107	0.516	1.039	0.005	0.019	0.018	527.304	0.021	0.004
Excavators	2030	600	750	0.220	0.185	1.399	1.342	0.005	0.056	0.051	531.157	0.022	0.004
Excavators	2030	750	999	0.093	0.078	2.329	0.979	0.005	0.021	0.019	528.437	0.021	0.004
Excavators	2031	0	25	1.043	0.862	6.477	3.535	0.011	0.246	0.226	847.502	0.034	0.007
Excavators	2031	25	50	0.366	0.308	3.283	4.166	0.005	0.058	0.053	588.066	0.024	0.005
Excavators	2031	50	75	1.530	1.286	8.390	4.558	0.005	0.981	0.903	527.007	0.021	0.004
Excavators	2031	75	100	0.183	0.154	1.624	3.443	0.005	0.034	0.032	524.860	0.021	0.004
Excavators	2031	100	175	0.153	0.129	0.688	3.091	0.005	0.033	0.031	528.144	0.021	0.004
Excavators	2031	175	300	0.143	0.120	0.639	1.099	0.005	0.024	0.022	528.080	0.021	0.004
Excavators	2031	300	600	0.125	0.105	0.484	1.038	0.005	0.018	0.017	527.304	0.021	0.004
Excavators	2031	600	750	0.216	0.182	1.333	1.342	0.005	0.052	0.048	531.157	0.022	0.004
Excavators	2031	750	999	0.093	0.078	2.329	0.979	0.005	0.021	0.019	528.437	0.021	0.004
Excavators	2032	0	25	1.043	0.863	6.478	3.535	0.011	0.246	0.226	847.637	0.034	0.007
Excavators	2032	25	50	0.346	0.291	3.271	4.146	0.005	0.049	0.045	588.066	0.024	0.005
Excavators	2032	50	75	1.410	1.185	8.075	4.500	0.005	0.905	0.832	527.007	0.021	0.004
Excavators	2032	75	100	0.181	0.152	1.588	3.442	0.005	0.032	0.030	524.860	0.021	0.004
Excavators	2032	100	175	0.149	0.125	0.635	3.088	0.005	0.031	0.028	528.144	0.021	0.004
Excavators	2032	175	300	0.142	0.119	0.606	1.097	0.005	0.023	0.022	528.080	0.021	0.004
Excavators	2032	300	600	0.125	0.105	0.467	1.035	0.005	0.018	0.017	527.304	0.021	0.004
Excavators	2032	600	750	0.216	0.181	1.315	1.342	0.005	0.052	0.048	531.157	0.022	0.004
Excavators	2032	750	999	0.093	0.078	2.329	0.979	0.005	0.021	0.019	528.437	0.021	0.004
Excavators	2033	0	25	1.043	0.862	6.474	3.533	0.011	0.246	0.226	847.150	0.034	0.007
Excavators	2033	25	50	0.334	0.281	3.262	4.134	0.005	0.043	0.040	588.066	0.024	0.005
Excavators	2033	50	75	0.988	0.831	6.904	4.295	0.005	0.641	0.589	527.007	0.021	0.004
Excavators	2033	75	100	0.180	0.151	1.565	3.442	0.005	0.030	0.027	524.860	0.021	0.004
Excavators	2033	100	175	0.147	0.123	0.603	3.086	0.005	0.030	0.027	528.144	0.021	0.004
Excavators	2033	175	300	0.139	0.117	0.569	1.092	0.005	0.022	0.020	528.080	0.021	0.004
Excavators	2033	300	600	0.124	0.104	0.445	1.032	0.005	0.017	0.016	527.304	0.021	0.004
Excavators	2033	600	750	0.216	0.181	1.315	1.342	0.005	0.052	0.048	531.157	0.022	0.004
Excavators	2033	750	999	0.090	0.076	2.329	0.979	0.005	0.020	0.018	528.437	0.021	0.004
Excavators	2034	0	25	1.043	0.862	6.474	3.533	0.011	0.246	0.226	847.141	0.034	0.007
Excavators	2034	25	50	0.327	0.275	3.239	4.127	0.005	0.039	0.036	588.066	0.024	0.005
Excavators	2034	50	75	0.753	0.632	6.292	4.179	0.005	0.492	0.452	527.007	0.021	0.004
Excavators	2034	75	100	0.178	0.150	1.544	3.442	0.005	0.028	0.026	524.860	0.021	0.004
Excavators	2034	100	175	0.144	0.121	0.572	3.086	0.005	0.028	0.026	528.144	0.021	0.004
Excavators	2034	175	300	0.138	0.116	0.545	1.086	0.005	0.021	0.019	528.080	0.021	0.004
Excavators	2034	300	600	0.122	0.103	0.425	1.031	0.005	0.016	0.014	527.304	0.021	0.004
Excavators	2034	600	750	0.213	0.179	1.145	1.342	0.005	0.052	0.047	531.157	0.022	0.004
Excavators	2034	750	999	0.090	0.076	2.329	0.979	0.005	0.020	0.018	528.437	0.021	0.004
Excavators	2035	0	25	1.042	0.862	6.472	3.532	0.011	0.246	0.226	846.850	0.034	0.007
Excavators	2035	25	50	0.322	0.271	3.212	4.123	0.005	0.035	0.032	588.066	0.024	0.005
Excavators	2035	50	75	0.647	0.544	5.832	4.125	0.005	0.422	0.388	527.007	0.021	0.004
Excavators	2035	75	100	0.176	0.148	1.529	3.441	0.005	0.026	0.024	524.860	0.021	0.004
Excavators	2035	100	175	0.141	0.118	0.545	3.085	0.005	0.025	0.023	528.144	0.021	0.004
Excavators	2035	175	300	0.135	0.114	0.513	1.083	0.005	0.019	0.018	528.080	0.021	0.004
Excavators	2035	300	600	0.121	0.102	0.408	1.028	0.005	0.015	0.014	527.304	0.021	0.004
Excavators	2035	600	750	0.200	0.168	1.006	1.342	0.005	0.037	0.034	531.157	0.022	0.004
Excavators	2035	750	999	0.090	0.076	2.329	0.979	0.005	0.020	0.018	528.437	0.021	0.004
Forklifts	2025	25	50	0.757	0.636	3.929	5.026	0.005	0.178	0.164	587.350	0.024	0.005
Forklifts	2025	50	75	2.030	1.706	13.424	5.618	0.005	1.044	0.961	520.490	0.021	0.004
Forklifts	2025	75	100	0.321	0.269	2.551	3.599	0.005	0.135	0.124	527.108	0.021	0.004
Forklifts	2025	100	175	0.250	0.210	1.661	3.169	0.005	0.085	0.078	527.465	0.021	0.004
Forklifts	2025	175	300	0.222	0.187	1.426	1.204	0.005	0.055	0.050	528.244	0.021	0.004
Forklifts	2025	300	600	0.276	0.232	1.832	1.254	0.005	0.068	0.063	531.099	0.022	0.004
Forklifts	2025	600	750	0.276	0.232	1.832	1.254	0.005	0.068	0.063	531.099	0.022	0.004
Forklifts	2025	750	999	0.135	0.114	2.432	1.045	0.005	0.023	0.021	527.640	0.021	0.004
Forklifts	2026	25	50	0.720	0.605	3.821	4.987	0.005	0.158	0.145	587.229	0.024	0.005

Unmitigated EFs from Caleemod 2022 (based on OFFROAD 2017) Appx G, Table G-11

Equipment	Year	Low HP	High HP	TOG	ROG	NOX	CO	SO2	PM10	PM2.5	CO2	CH4	N2O
Forklifts	2026	50	75	1.994	1.675	13.173	5.532	0.005	1.034	0.952	520.592	0.021	0.004
Forklifts	2026	75	100	0.293	0.246	2.342	3.579	0.005	0.112	0.103	527.097	0.021	0.004
Forklifts	2026	100	175	0.229	0.192	1.435	3.159	0.005	0.072	0.066	527.468	0.021	0.004
Forklifts	2026	175	300	0.225	0.189	1.408	1.213	0.005	0.054	0.049	528.244	0.021	0.004
Forklifts	2026	300	600	0.273	0.229	1.761	1.257	0.005	0.064	0.059	531.099	0.022	0.004
Forklifts	2026	600	750	0.273	0.229	1.761	1.257	0.005	0.064	0.059	531.099	0.022	0.004
Forklifts	2026	750	999	0.144	0.121	2.451	1.057	0.005	0.023	0.022	527.640	0.021	0.004
Forklifts	2027	25	50	0.686	0.577	3.746	4.957	0.005	0.142	0.131	587.187	0.024	0.005
Forklifts	2027	50	75	0.833	0.700	7.151	4.374	0.005	0.491	0.452	526.084	0.021	0.004
Forklifts	2027	75	100	0.272	0.228	2.152	3.568	0.005	0.092	0.085	527.070	0.021	0.004
Forklifts	2027	100	175	0.212	0.178	1.251	3.160	0.005	0.061	0.056	527.421	0.021	0.004
Forklifts	2027	175	300	0.224	0.188	1.343	1.219	0.005	0.051	0.047	528.244	0.021	0.004
Forklifts	2027	300	600	0.272	0.229	1.724	1.260	0.005	0.064	0.059	531.099	0.022	0.004
Forklifts	2027	600	750	0.272	0.229	1.724	1.260	0.005	0.064	0.059	531.099	0.022	0.004
Forklifts	2027	750	999	0.152	0.128	2.471	1.070	0.005	0.024	0.022	527.640	0.021	0.004
Forklifts	2028	25	50	0.678	0.569	3.708	4.980	0.005	0.133	0.123	587.187	0.024	0.005
Forklifts	2028	50	75	0.913	0.767	7.507	4.410	0.005	0.541	0.498	525.610	0.021	0.004
Forklifts	2028	75	100	0.257	0.216	2.032	3.565	0.005	0.079	0.072	527.025	0.021	0.004
Forklifts	2028	100	175	0.200	0.168	1.106	3.165	0.005	0.053	0.049	527.554	0.021	0.004
Forklifts	2028	175	300	0.218	0.183	1.218	1.221	0.005	0.047	0.043	528.243	0.021	0.004
Forklifts	2028	300	600	0.239	0.201	1.311	1.241	0.005	0.049	0.045	527.648	0.021	0.004
Forklifts	2028	600	750	0.239	0.201	1.311	1.241	0.005	0.049	0.045	527.648	0.021	0.004
Forklifts	2028	750	999	0.160	0.135	2.490	1.082	0.005	0.025	0.023	527.640	0.021	0.004
Forklifts	2029	25	50	0.665	0.558	3.655	4.970	0.005	0.122	0.112	587.137	0.024	0.005
Forklifts	2029	50	75	0.915	0.769	7.500	4.399	0.005	0.544	0.500	525.717	0.021	0.004
Forklifts	2029	75	100	0.249	0.210	1.956	3.570	0.005	0.070	0.065	527.076	0.021	0.004
Forklifts	2029	100	175	0.196	0.165	1.027	3.177	0.005	0.048	0.044	527.561	0.021	0.004
Forklifts	2029	175	300	0.218	0.183	1.176	1.225	0.005	0.045	0.041	528.228	0.021	0.004
Forklifts	2029	300	600	0.244	0.205	1.428	1.252	0.005	0.054	0.049	527.649	0.021	0.004
Forklifts	2029	600	750	0.244	0.205	1.428	1.252	0.005	0.054	0.049	527.649	0.021	0.004
Forklifts	2029	750	999	0.169	0.142	2.510	1.095	0.005	0.025	0.023	527.640	0.021	0.004
Forklifts	2030	25	50	0.629	0.529	3.590	4.932	0.005	0.109	0.100	587.137	0.024	0.005
Forklifts	2030	50	75	0.830	0.697	5.774	4.361	0.005	0.459	0.423	525.717	0.021	0.004
Forklifts	2030	75	100	0.242	0.203	1.909	3.566	0.005	0.064	0.059	527.076	0.021	0.004
Forklifts	2030	100	175	0.188	0.158	0.935	3.176	0.005	0.043	0.040	527.561	0.021	0.004
Forklifts	2030	175	300	0.212	0.178	1.061	1.224	0.005	0.041	0.038	528.228	0.021	0.004
Forklifts	2030	300	600	0.237	0.200	1.350	1.252	0.005	0.054	0.049	527.649	0.021	0.004
Forklifts	2030	600	750	0.237	0.200	1.350	1.252	0.005	0.054	0.049	527.649	0.021	0.004
Forklifts	2030	750	999	0.169	0.142	2.510	1.095	0.005	0.025	0.023	527.640	0.021	0.004
Forklifts	2031	25	50	0.599	0.503	3.559	4.899	0.005	0.098	0.090	587.137	0.024	0.005
Forklifts	2031	50	75	0.796	0.669	5.539	4.281	0.005	0.450	0.414	525.717	0.021	0.004
Forklifts	2031	75	100	0.233	0.196	1.832	3.562	0.005	0.057	0.053	527.076	0.021	0.004
Forklifts	2031	100	175	0.181	0.152	0.847	3.176	0.005	0.041	0.038	527.561	0.021	0.004
Forklifts	2031	175	300	0.207	0.174	0.998	1.224	0.005	0.041	0.038	528.228	0.021	0.004
Forklifts	2031	300	600	0.227	0.190	1.224	1.252	0.005	0.054	0.049	527.649	0.021	0.004
Forklifts	2031	600	750	0.227	0.190	1.224	1.252	0.005	0.054	0.049	527.649	0.021	0.004
Forklifts	2031	750	999	0.169	0.142	2.510	1.095	0.005	0.025	0.023	527.640	0.021	0.004
Forklifts	2032	25	50	0.578	0.486	3.530	4.879	0.005	0.091	0.084	587.137	0.024	0.005
Forklifts	2032	50	75	0.796	0.669	5.539	4.281	0.005	0.450	0.414	525.717	0.021	0.004
Forklifts	2032	75	100	0.227	0.191	1.774	3.559	0.005	0.053	0.049	527.076	0.021	0.004
Forklifts	2032	100	175	0.176	0.148	0.786	3.175	0.005	0.039	0.036	527.561	0.021	0.004
Forklifts	2032	175	300	0.203	0.171	0.952	1.221	0.005	0.039	0.035	528.228	0.021	0.004
Forklifts	2032	300	600	0.227	0.190	1.224	1.252	0.005	0.054	0.049	527.649	0.021	0.004
Forklifts	2032	600	750	0.227	0.190	1.224	1.252	0.005	0.054	0.049	527.649	0.021	0.004
Forklifts	2032	750	999	0.169	0.142	2.510	1.095	0.005	0.025	0.023	527.640	0.021	0.004
Forklifts	2033	25	50	0.555	0.467	3.512	4.854	0.005	0.083	0.077	587.137	0.024	0.005
Forklifts	2033	50	75	0.782	0.658	5.446	4.249	0.005	0.457	0.421	525.717	0.021	0.004
Forklifts	2033	75	100	0.221	0.186	1.733	3.557	0.005	0.048	0.044	527.076	0.021	0.004
Forklifts	2033	100	175	0.171	0.144	0.721	3.174	0.005	0.038	0.035	527.561	0.021	0.004
Forklifts	2033	175	300	0.197	0.165	0.883	1.215	0.005	0.035	0.033	528.228	0.021	0.004
Forklifts	2033	300	600	0.225	0.189	1.169	1.252	0.005	0.052	0.048	527.649	0.021	0.004
Forklifts	2033	600	750	0.225	0.189	1.169	1.252	0.005	0.052	0.048	527.649	0.021	0.004
Forklifts	2033	750	999	0.169	0.142	2.510	1.095	0.005	0.025	0.023	527.640	0.021	0.004
Forklifts	2034	25	50	0.533	0.448	3.464	4.831	0.005	0.074	0.068	587.137	0.024	0.005
Forklifts	2034	50	75	0.758	0.637	5.169	4.249	0.005	0.348	0.320	525.717	0.021	0.004
Forklifts	2034	75	100	0.216	0.182	1.703	3.555	0.005	0.045	0.041	527.076	0.021	0.004

Unmitigated EFs from Caleemod 2022 (based on OFFROAD 2017) Appx G, Table G-11

Equipment	Year	Low HP	High HP	TOG	ROG	NOX	CO	SO2	PM10	PM2.5	CO2	CH4	N2O
Forklifts	2034	100	175	0.168	0.141	0.695	3.174	0.005	0.035	0.033	527.561	0.021	0.004
Forklifts	2034	175	300	0.192	0.161	0.818	1.211	0.005	0.033	0.030	528.228	0.021	0.004
Forklifts	2034	300	600	0.206	0.173	0.946	1.252	0.005	0.031	0.029	527.649	0.021	0.004
Forklifts	2034	600	750	0.206	0.173	0.946	1.252	0.005	0.031	0.029	527.649	0.021	0.004
Forklifts	2034	750	999	0.169	0.142	2.510	1.095	0.005	0.025	0.023	527.640	0.021	0.004
Forklifts	2035	25	50	0.515	0.432	3.431	4.812	0.005	0.067	0.062	587.137	0.024	0.005
Forklifts	2035	50	75	0.758	0.637	5.169	4.249	0.005	0.348	0.320	525.717	0.021	0.004
Forklifts	2035	75	100	0.211	0.178	1.669	3.553	0.005	0.040	0.036	527.076	0.021	0.004
Forklifts	2035	100	175	0.166	0.139	0.676	3.173	0.005	0.033	0.030	527.561	0.021	0.004
Forklifts	2035	175	300	0.187	0.157	0.773	1.199	0.005	0.031	0.028	528.228	0.021	0.004
Forklifts	2035	300	600	0.195	0.164	0.895	1.207	0.005	0.026	0.024	527.649	0.021	0.004
Forklifts	2035	600	750	0.195	0.164	0.895	1.207	0.005	0.026	0.024	527.649	0.021	0.004
Forklifts	2035	750	999	0.169	0.142	2.510	1.095	0.005	0.025	0.023	527.640	0.021	0.004
Generator Sets	2025	0	25	0.656	0.542	4.347	2.869	0.008	0.177	0.163	568.322	0.023	0.005
Generator Sets	2025	25	50	0.441	0.364	3.482	3.759	0.007	0.093	0.086	568.312	0.023	0.005
Generator Sets	2026	0	25	0.653	0.539	4.324	2.860	0.008	0.174	0.160	568.327	0.023	0.005
Generator Sets	2026	25	50	0.409	0.338	3.382	3.731	0.007	0.079	0.073	568.315	0.023	0.005
Generator Sets	2027	0	25	0.650	0.537	4.305	2.852	0.008	0.172	0.158	568.306	0.023	0.005
Generator Sets	2027	25	50	0.379	0.314	3.286	3.704	0.007	0.066	0.060	568.333	0.023	0.005
Generator Sets	2028	0	25	0.648	0.535	4.289	2.846	0.008	0.170	0.156	568.300	0.023	0.005
Generator Sets	2028	25	50	0.354	0.292	3.197	3.678	0.007	0.053	0.049	568.314	0.023	0.005
Generator Sets	2029	0	25	0.646	0.534	4.276	2.842	0.008	0.168	0.154	568.317	0.023	0.005
Generator Sets	2029	25	50	0.332	0.275	3.144	3.657	0.007	0.045	0.041	568.304	0.023	0.005
Generator Sets	2030	0	25	0.645	0.533	4.267	2.840	0.008	0.166	0.153	568.320	0.023	0.005
Generator Sets	2030	25	50	0.315	0.261	3.107	3.641	0.007	0.038	0.035	568.301	0.023	0.005
Generator Sets	2031	0	25	0.644	0.532	4.260	2.839	0.008	0.165	0.152	568.306	0.023	0.005
Generator Sets	2031	25	50	0.302	0.250	3.077	3.628	0.007	0.033	0.030	568.336	0.023	0.005
Generator Sets	2032	0	25	0.644	0.532	4.256	2.839	0.008	0.164	0.151	568.305	0.023	0.005
Generator Sets	2032	25	50	0.292	0.241	3.051	3.619	0.007	0.028	0.026	568.308	0.023	0.005
Generator Sets	2033	0	25	0.644	0.532	4.253	2.839	0.008	0.163	0.150	568.308	0.023	0.005
Generator Sets	2033	25	50	0.284	0.235	3.027	3.613	0.007	0.024	0.022	568.314	0.023	0.005
Generator Sets	2034	0	25	0.643	0.532	4.250	2.839	0.008	0.163	0.150	568.303	0.023	0.005
Generator Sets	2034	25	50	0.280	0.231	3.008	3.610	0.007	0.021	0.020	568.314	0.023	0.005
Generator Sets	2035	0	25	0.643	0.532	4.249	2.839	0.008	0.162	0.149	568.317	0.023	0.005
Generator Sets	2035	25	50	0.277	0.229	2.992	3.608	0.007	0.019	0.017	568.291	0.023	0.005
Graders	2025	0	25	2.366	1.988	6.089	7.740	0.005	0.734	0.675	587.012	0.024	0.005
Graders	2025	25	50	2.356	1.980	5.334	7.562	0.005	0.548	0.505	586.256	0.024	0.005
Graders	2025	50	75	1.762	1.481	11.526	5.017	0.005	0.992	0.912	544.098	0.022	0.004
Graders	2025	75	100	0.635	0.534	4.218	3.970	0.005	0.310	0.286	522.945	0.021	0.004
Graders	2025	100	175	0.404	0.340	2.859	3.419	0.005	0.159	0.146	531.194	0.022	0.004
Graders	2025	175	300	0.282	0.237	2.445	1.213	0.005	0.081	0.075	527.706	0.021	0.004
Graders	2025	300	600	0.347	0.292	3.115	1.098	0.005	0.113	0.104	525.708	0.021	0.004
Graders	2025	600	750	0.347	0.292	3.115	1.098	0.005	0.113	0.104	525.708	0.021	0.004
Graders	2025	750	999	0.256	0.215	3.876	1.380	0.005	0.085	0.078	528.121	0.021	0.004
Graders	2026	25	50	2.043	1.716	5.083	7.070	0.005	0.486	0.447	585.686	0.024	0.005
Graders	2026	50	75	1.819	1.528	9.218	5.664	0.005	0.792	0.728	563.142	0.023	0.005
Graders	2026	75	100	0.594	0.499	3.931	3.967	0.005	0.280	0.257	524.029	0.021	0.004
Graders	2026	100	175	0.372	0.313	2.528	3.397	0.005	0.140	0.129	530.815	0.022	0.004
Graders	2026	175	300	0.261	0.219	2.119	1.197	0.005	0.071	0.066	527.697	0.021	0.004
Graders	2026	300	600	0.262	0.220	2.098	1.056	0.005	0.078	0.072	524.468	0.021	0.004
Graders	2026	600	750	0.262	0.220	2.098	1.056	0.005	0.078	0.072	524.468	0.021	0.004
Graders	2026	750	999	0.266	0.223	3.915	1.406	0.005	0.087	0.080	528.121	0.021	0.004
Graders	2027	0	25	3.488	2.931	6.356	8.830	0.005	0.884	0.813	586.870	0.024	0.005
Graders	2027	25	50	1.689	1.419	4.702	6.663	0.005	0.375	0.345	585.895	0.024	0.005
Graders	2027	50	75	1.859	1.562	12.195	5.250	0.005	1.021	0.939	546.720	0.022	0.004
Graders	2027	75	100	0.531	0.446	3.565	3.946	0.005	0.232	0.214	525.733	0.021	0.004
Graders	2027	100	175	0.351	0.295	2.284	3.406	0.005	0.127	0.117	531.253	0.022	0.004
Graders	2027	175	300	0.242	0.204	1.835	1.180	0.005	0.063	0.058	527.975	0.021	0.004
Graders	2027	300	600	0.286	0.240	2.318	1.066	0.005	0.087	0.080	522.633	0.021	0.004
Graders	2027	600	750	0.286	0.240	2.318	1.066	0.005	0.087	0.080	522.633	0.021	0.004
Graders	2027	750	999	0.276	0.232	3.954	1.433	0.005	0.088	0.081	527.969	0.021	0.004
Graders	2028	0	25	0.633	0.532	3.517	4.465	0.005	0.140	0.129	587.027	0.024	0.005
Graders	2028	25	50	1.704	1.431	4.686	6.768	0.005	0.364	0.335	587.227	0.024	0.005
Graders	2028	50	75	1.947	1.636	12.806	5.464	0.005	1.048	0.964	549.247	0.022	0.004
Graders	2028	75	100	0.510	0.428	3.389	3.952	0.005	0.211	0.194	525.513	0.021	0.004
Graders	2028	100	175	0.335	0.281	2.086	3.418	0.005	0.116	0.106	531.332	0.022	0.004
Graders	2028	175	300	0.234	0.196	1.679	1.174	0.005	0.058	0.053	528.025	0.021	0.004
Graders	2028	300	600	0.284	0.239	2.285	1.065	0.005	0.084	0.078	520.049	0.021	0.004

Unmitigated EFs from Caleemod 2022 (based on OFFROAD 2017) Appx G, Table G-11

Equipment	Year	Low HP	High HP	TOG	ROG	NOX	CO	SO2	PM10	PM2.5	CO2	CH4	N2O
Graders	2028	600	750	0.284	0.239	2.285	1.065	0.005	0.084	0.078	520.049	0.021	0.004
Graders	2028	750	999	0.285	0.240	3.996	1.461	0.005	0.090	0.082	527.969	0.021	0.004
Graders	2029	0	25	0.651	0.547	3.542	4.577	0.005	0.141	0.130	586.940	0.024	0.005
Graders	2029	25	50	1.722	1.447	4.711	6.876	0.005	0.365	0.336	587.151	0.024	0.005
Graders	2029	50	75	1.650	1.387	11.131	5.256	0.005	0.821	0.755	528.475	0.021	0.004
Graders	2029	75	100	0.477	0.401	3.144	3.950	0.005	0.186	0.171	527.494	0.021	0.004
Graders	2029	100	175	0.317	0.266	1.891	3.426	0.005	0.103	0.095	531.047	0.022	0.004
Graders	2029	175	300	0.229	0.192	1.561	1.175	0.005	0.054	0.050	527.954	0.021	0.004
Graders	2029	300	600	0.234	0.197	1.679	1.058	0.005	0.061	0.056	525.026	0.021	0.004
Graders	2029	600	750	0.234	0.197	1.679	1.058	0.005	0.061	0.056	525.026	0.021	0.004
Graders	2029	750	999	0.295	0.248	4.037	1.490	0.005	0.091	0.084	527.664	0.021	0.004
Graders	2030	0	25	0.480	0.403	3.494	4.411	0.005	0.118	0.109	586.940	0.024	0.005
Graders	2030	25	50	1.640	1.378	4.695	6.800	0.005	0.355	0.327	587.151	0.024	0.005
Graders	2030	50	75	1.650	1.387	11.131	5.256	0.005	0.821	0.755	528.475	0.021	0.004
Graders	2030	75	100	0.460	0.387	3.036	3.940	0.005	0.175	0.161	527.494	0.021	0.004
Graders	2030	100	175	0.304	0.255	1.763	3.419	0.005	0.098	0.090	531.047	0.022	0.004
Graders	2030	175	300	0.224	0.188	1.467	1.166	0.005	0.051	0.047	527.954	0.021	0.004
Graders	2030	300	600	0.232	0.195	1.551	1.058	0.005	0.061	0.056	525.026	0.021	0.004
Graders	2030	600	750	0.232	0.195	1.551	1.058	0.005	0.061	0.056	525.026	0.021	0.004
Graders	2030	750	999	0.257	0.216	3.772	1.274	0.005	0.077	0.071	527.664	0.021	0.004
Graders	2031	0	25	0.394	0.331	3.480	4.329	0.005	0.084	0.078	586.940	0.024	0.005
Graders	2031	25	50	1.537	1.292	4.671	6.699	0.005	0.341	0.314	587.151	0.024	0.005
Graders	2031	50	75	1.512	1.271	10.013	4.928	0.005	0.790	0.727	528.475	0.021	0.004
Graders	2031	75	100	0.441	0.370	2.924	3.932	0.005	0.162	0.149	527.494	0.021	0.004
Graders	2031	100	175	0.297	0.250	1.681	3.411	0.005	0.096	0.088	531.047	0.022	0.004
Graders	2031	175	300	0.218	0.183	1.305	1.165	0.005	0.045	0.042	527.954	0.021	0.004
Graders	2031	300	600	0.230	0.193	1.334	1.058	0.005	0.061	0.056	525.026	0.021	0.004
Graders	2031	600	750	0.230	0.193	1.334	1.058	0.005	0.061	0.056	525.026	0.021	0.004
Graders	2031	750	999	0.256	0.215	3.746	1.274	0.005	0.077	0.071	527.664	0.021	0.004
Graders	2032	0	25	0.366	0.308	3.475	4.300	0.005	0.080	0.074	586.940	0.024	0.005
Graders	2032	25	50	1.512	1.271	4.664	6.678	0.005	0.338	0.311	587.151	0.024	0.005
Graders	2032	50	75	1.512	1.271	10.013	4.928	0.005	0.790	0.727	528.475	0.021	0.004
Graders	2032	75	100	0.427	0.359	2.812	3.916	0.005	0.154	0.142	527.494	0.021	0.004
Graders	2032	100	175	0.288	0.242	1.598	3.408	0.005	0.091	0.084	531.047	0.022	0.004
Graders	2032	175	300	0.208	0.175	1.153	1.159	0.005	0.041	0.038	527.954	0.021	0.004
Graders	2032	300	600	0.230	0.193	1.252	1.058	0.005	0.061	0.056	525.026	0.021	0.004
Graders	2032	600	750	0.230	0.193	1.252	1.058	0.005	0.061	0.056	525.026	0.021	0.004
Graders	2032	750	999	0.256	0.215	3.763	1.274	0.005	0.080	0.074	527.664	0.021	0.004
Graders	2033	0	25	0.366	0.308	3.475	4.300	0.005	0.080	0.074	586.940	0.024	0.005
Graders	2033	25	50	1.462	1.228	4.610	6.629	0.005	0.296	0.272	587.151	0.024	0.005
Graders	2033	50	75	1.512	1.271	10.013	4.928	0.005	0.790	0.727	528.475	0.021	0.004
Graders	2033	75	100	0.412	0.346	2.752	3.903	0.005	0.145	0.134	527.494	0.021	0.004
Graders	2033	100	175	0.280	0.235	1.528	3.401	0.005	0.085	0.078	531.047	0.022	0.004
Graders	2033	175	300	0.205	0.172	1.070	1.157	0.005	0.038	0.035	527.954	0.021	0.004
Graders	2033	300	600	0.230	0.193	1.227	1.058	0.005	0.060	0.055	525.026	0.021	0.004
Graders	2033	600	750	0.230	0.193	1.227	1.058	0.005	0.060	0.055	525.026	0.021	0.004
Graders	2033	750	999	0.256	0.215	3.738	1.274	0.005	0.080	0.074	527.664	0.021	0.004
Graders	2034	0	25	0.337	0.283	3.470	4.273	0.005	0.055	0.051	586.940	0.024	0.005
Graders	2034	25	50	1.393	1.171	4.524	6.479	0.005	0.286	0.263	587.151	0.024	0.005
Graders	2034	50	75	1.512	1.271	10.013	4.928	0.005	0.790	0.727	528.475	0.021	0.004
Graders	2034	75	100	0.395	0.332	2.658	3.892	0.005	0.135	0.124	527.494	0.021	0.004
Graders	2034	100	175	0.271	0.228	1.465	3.396	0.005	0.080	0.074	531.047	0.022	0.004
Graders	2034	175	300	0.196	0.165	0.960	1.153	0.005	0.034	0.032	527.954	0.021	0.004
Graders	2034	300	600	0.210	0.177	1.020	1.058	0.005	0.038	0.035	525.026	0.021	0.004
Graders	2034	600	750	0.210	0.177	1.020	1.058	0.005	0.038	0.035	525.026	0.021	0.004
Graders	2034	750	999	0.256	0.215	3.553	1.274	0.005	0.074	0.068	527.664	0.021	0.004
Graders	2035	0	25	0.337	0.283	3.470	4.273	0.005	0.055	0.051	586.940	0.024	0.005
Graders	2035	25	50	1.382	1.161	4.522	6.469	0.005	0.276	0.254	587.151	0.024	0.005
Graders	2035	50	75	1.512	1.271	10.013	4.928	0.005	0.790	0.727	528.475	0.021	0.004
Graders	2035	75	100	0.373	0.314	2.558	3.881	0.005	0.118	0.109	527.494	0.021	0.004
Graders	2035	100	175	0.264	0.222	1.418	3.393	0.005	0.075	0.069	531.047	0.022	0.004
Graders	2035	175	300	0.184	0.155	0.814	1.150	0.005	0.029	0.027	527.954	0.021	0.004
Graders	2035	300	600	0.206	0.173	0.968	1.058	0.005	0.033	0.030	525.026	0.021	0.004
Graders	2035	600	750	0.206	0.173	0.968	1.058	0.005	0.033	0.030	525.026	0.021	0.004
Graders	2035	750	999	0.256	0.215	3.553	1.274	0.005	0.074	0.068	527.664	0.021	0.004
Off-Highway Tractors	2025	0	25	4.827	4.056	7.675	11.147	0.005	1.055	0.971	586.526	0.024	0.005

Unmitigated EFs from Caleemod 2022 (based on OFFROAD 2017) Appx G, Table G-11

Equipment	Year	Low HP	High HP	TOG	ROG	NOX	CO	SO2	PM10	PM2.5	CO2	CH4	N2O
Off-Highway Tractors	2025	25	50	0.613	0.515	3.682	4.608	0.005	0.140	0.128	586.153	0.024	0.005
Off-Highway Tractors	2025	50	75	0.431	0.362	3.303	3.811	0.005	0.193	0.177	526.613	0.021	0.004
Off-Highway Tractors	2025	75	100	0.254	0.213	2.260	3.515	0.005	0.109	0.100	529.622	0.021	0.004
Off-Highway Tractors	2025	100	175	0.208	0.175	1.344	3.131	0.005	0.064	0.059	527.455	0.021	0.004
Off-Highway Tractors	2025	175	300	0.187	0.157	1.154	1.138	0.005	0.042	0.038	527.781	0.021	0.004
Off-Highway Tractors	2025	300	600	0.150	0.126	0.750	1.051	0.005	0.026	0.024	526.647	0.021	0.004
Off-Highway Tractors	2025	600	750	0.301	0.253	1.717	1.093	0.005	0.089	0.082	524.144	0.021	0.004
Off-Highway Tractors	2025	750	999	0.238	0.200	2.856	1.060	0.005	0.062	0.057	527.647	0.021	0.004
Off-Highway Tractors	2026	25	50	0.584	0.490	3.617	4.600	0.005	0.126	0.116	586.163	0.024	0.005
Off-Highway Tractors	2026	50	75	0.361	0.303	2.703	3.698	0.005	0.137	0.126	526.237	0.021	0.004
Off-Highway Tractors	2026	75	100	0.257	0.216	2.289	3.558	0.005	0.107	0.098	530.185	0.022	0.004
Off-Highway Tractors	2026	100	175	0.196	0.165	1.192	3.142	0.005	0.055	0.051	527.971	0.021	0.004
Off-Highway Tractors	2026	175	300	0.178	0.150	1.022	1.137	0.005	0.037	0.034	527.666	0.021	0.004
Off-Highway Tractors	2026	300	600	0.153	0.129	0.738	1.057	0.005	0.026	0.024	526.897	0.021	0.004
Off-Highway Tractors	2026	600	750	0.304	0.256	1.717	1.098	0.005	0.089	0.082	524.464	0.021	0.004
Off-Highway Tractors	2026	750	999	0.248	0.208	2.874	1.071	0.005	0.063	0.058	527.646	0.021	0.004
Off-Highway Tractors	2027	0	25	4.766	4.005	7.614	11.147	0.005	1.055	0.971	586.558	0.024	0.005
Off-Highway Tractors	2027	25	50	0.539	0.453	3.536	4.569	0.005	0.107	0.098	586.150	0.024	0.005
Off-Highway Tractors	2027	50	75	0.332	0.279	2.422	3.682	0.005	0.109	0.100	526.372	0.021	0.004
Off-Highway Tractors	2027	75	100	0.253	0.212	2.277	3.576	0.005	0.099	0.091	530.122	0.022	0.004
Off-Highway Tractors	2027	100	175	0.197	0.165	1.143	3.164	0.005	0.052	0.048	527.905	0.021	0.004
Off-Highway Tractors	2027	175	300	0.174	0.146	0.916	1.141	0.005	0.033	0.031	527.608	0.021	0.004
Off-Highway Tractors	2027	300	600	0.152	0.127	0.654	1.061	0.005	0.023	0.021	527.392	0.021	0.004
Off-Highway Tractors	2027	600	750	0.307	0.258	1.716	1.102	0.005	0.089	0.082	524.285	0.021	0.004
Off-Highway Tractors	2027	750	999	0.258	0.217	2.891	1.081	0.005	0.064	0.059	527.633	0.021	0.004
Off-Highway Tractors	2028	0	25	4.765	4.004	7.612	11.146	0.005	1.055	0.971	586.486	0.024	0.005
Off-Highway Tractors	2028	25	50	0.526	0.442	3.502	4.600	0.005	0.096	0.089	586.269	0.024	0.005
Off-Highway Tractors	2028	50	75	0.294	0.247	2.243	3.624	0.005	0.089	0.082	526.790	0.021	0.004
Off-Highway Tractors	2028	75	100	0.262	0.220	2.273	3.624	0.005	0.100	0.092	530.972	0.022	0.004
Off-Highway Tractors	2028	100	175	0.174	0.147	0.890	3.138	0.005	0.038	0.035	528.002	0.021	0.004
Off-Highway Tractors	2028	175	300	0.163	0.137	0.729	1.129	0.005	0.027	0.025	527.557	0.021	0.004
Off-Highway Tractors	2028	300	600	0.147	0.123	0.571	1.061	0.005	0.020	0.018	527.785	0.021	0.004
Off-Highway Tractors	2028	600	750	0.309	0.260	1.715	1.106	0.005	0.089	0.082	524.280	0.021	0.004
Off-Highway Tractors	2028	750	999	0.268	0.225	2.908	1.091	0.005	0.065	0.060	527.609	0.021	0.004
Off-Highway Tractors	2029	0	25	4.767	4.005	7.616	11.151	0.005	1.056	0.971	586.774	0.024	0.005
Off-Highway Tractors	2029	25	50	0.509	0.428	3.458	4.608	0.005	0.085	0.078	586.224	0.024	0.005
Off-Highway Tractors	2029	50	75	0.288	0.242	2.204	3.629	0.005	0.083	0.077	526.703	0.021	0.004
Off-Highway Tractors	2029	75	100	0.243	0.204	2.044	3.591	0.005	0.080	0.073	529.443	0.021	0.004
Off-Highway Tractors	2029	100	175	0.168	0.141	0.795	3.138	0.005	0.036	0.033	527.882	0.021	0.004
Off-Highway Tractors	2029	175	300	0.166	0.139	0.701	1.137	0.005	0.027	0.025	527.220	0.021	0.004
Off-Highway Tractors	2029	300	600	0.143	0.121	0.541	1.058	0.005	0.019	0.017	527.324	0.021	0.004
Off-Highway Tractors	2029	600	750	0.300	0.252	1.595	1.115	0.005	0.082	0.076	528.020	0.021	0.004
Off-Highway Tractors	2029	750	999	0.276	0.232	2.923	1.100	0.005	0.066	0.061	527.855	0.021	0.004
Off-Highway Tractors	2030	0	25	4.767	4.005	7.616	11.151	0.005	1.056	0.971	586.774	0.024	0.005
Off-Highway Tractors	2030	25	50	0.489	0.411	3.414	4.586	0.005	0.076	0.070	586.224	0.024	0.005
Off-Highway Tractors	2030	50	75	0.276	0.232	2.114	3.617	0.005	0.072	0.066	526.770	0.021	0.004
Off-Highway Tractors	2030	75	100	0.237	0.199	1.964	3.594	0.005	0.076	0.070	529.330	0.021	0.004
Off-Highway Tractors	2030	100	175	0.162	0.136	0.715	3.138	0.005	0.036	0.033	527.882	0.021	0.004
Off-Highway Tractors	2030	175	300	0.162	0.136	0.652	1.137	0.005	0.026	0.024	527.220	0.021	0.004
Off-Highway Tractors	2030	300	600	0.140	0.117	0.493	1.058	0.005	0.018	0.016	527.324	0.021	0.004
Off-Highway Tractors	2030	600	750	0.300	0.252	1.595	1.115	0.005	0.082	0.076	528.020	0.021	0.004
Off-Highway Tractors	2030	750	999	0.276	0.232	2.518	1.100	0.005	0.052	0.048	527.855	0.021	0.004
Off-Highway Tractors	2031	0	25	4.746	3.988	7.595	11.151	0.005	1.056	0.971	586.774	0.024	0.005
Off-Highway Tractors	2031	25	50	0.466	0.392	3.404	4.562	0.005	0.066	0.061	586.224	0.024	0.005
Off-Highway Tractors	2031	50	75	0.271	0.228	2.061	3.622	0.005	0.069	0.064	526.703	0.021	0.004
Off-Highway Tractors	2031	75	100	0.224	0.188	1.858	3.582	0.005	0.065	0.060	529.443	0.021	0.004
Off-Highway Tractors	2031	100	175	0.155	0.131	0.631	3.135	0.005	0.033	0.030	527.882	0.021	0.004
Off-Highway Tractors	2031	175	300	0.159	0.134	0.610	1.130	0.005	0.025	0.023	527.220	0.021	0.004
Off-Highway Tractors	2031	300	600	0.135	0.114	0.444	1.058	0.005	0.016	0.014	527.324	0.021	0.004
Off-Highway Tractors	2031	600	750	0.300	0.252	1.595	1.115	0.005	0.082	0.076	528.020	0.021	0.004
Off-Highway Tractors	2031	750	999	0.266	0.223	2.518	1.100	0.005	0.047	0.043	527.855	0.021	0.004
Off-Highway Tractors	2032	0	25	4.369	3.671	7.127	10.327	0.005	1.003	0.922	586.774	0.024	0.005
Off-Highway Tractors	2032	25	50	0.455	0.383	3.379	4.552	0.005	0.062	0.057	586.224	0.024	0.005
Off-Highway Tractors	2032	50	75	0.261	0.219	1.963	3.614	0.005	0.064	0.059	526.700	0.021	0.004
Off-Highway Tractors	2032	75	100	0.225	0.189	1.862	3.583	0.005	0.064	0.059	529.439	0.021	0.004
Off-Highway Tractors	2032	100	175	0.153	0.128	0.597	3.135	0.005	0.029	0.026	527.882	0.021	0.004

Unmitigated EFs from Caleemod 2022 (based on OFFROAD 2017) Appx G, Table G-11

Equipment	Year	Low HP	High HP	TOG	ROG	NOX	CO	SO2	PM10	PM2.5	CO2	CH4	N2O
Off-Highway Tractors	2032	175	300	0.157	0.132	0.573	1.129	0.005	0.024	0.022	527.220	0.021	0.004
Off-Highway Tractors	2032	300	600	0.131	0.110	0.394	1.058	0.005	0.013	0.012	527.324	0.021	0.004
Off-Highway Tractors	2032	600	750	0.300	0.252	1.595	1.115	0.005	0.082	0.076	528.020	0.021	0.004
Off-Highway Tractors	2032	750	999	0.266	0.223	2.518	1.100	0.005	0.047	0.043	527.855	0.021	0.004
Off-Highway Tractors	2033	0	25	4.369	3.671	7.127	10.327	0.005	1.003	0.922	586.774	0.024	0.005
Off-Highway Tractors	2033	25	50	0.444	0.373	3.349	4.541	0.005	0.056	0.052	586.224	0.024	0.005
Off-Highway Tractors	2033	50	75	0.257	0.216	1.952	3.613	0.005	0.060	0.055	526.700	0.021	0.004
Off-Highway Tractors	2033	75	100	0.219	0.184	1.780	3.581	0.005	0.051	0.047	529.439	0.021	0.004
Off-Highway Tractors	2033	100	175	0.151	0.127	0.587	3.135	0.005	0.022	0.020	527.882	0.021	0.004
Off-Highway Tractors	2033	175	300	0.156	0.131	0.566	1.129	0.005	0.024	0.022	527.220	0.021	0.004
Off-Highway Tractors	2033	300	600	0.131	0.110	0.378	1.058	0.005	0.013	0.012	527.324	0.021	0.004
Off-Highway Tractors	2033	600	750	0.300	0.252	1.595	1.115	0.005	0.082	0.076	528.020	0.021	0.004
Off-Highway Tractors	2033	750	999	0.218	0.184	2.518	1.100	0.005	0.036	0.033	527.855	0.021	0.004
Off-Highway Tractors	2034	0	25	4.369	3.671	7.127	10.327	0.005	1.003	0.922	586.774	0.024	0.005
Off-Highway Tractors	2034	25	50	0.429	0.360	3.308	4.525	0.005	0.049	0.045	586.224	0.024	0.005
Off-Highway Tractors	2034	50	75	0.256	0.215	1.919	3.613	0.005	0.060	0.055	526.703	0.021	0.004
Off-Highway Tractors	2034	75	100	0.214	0.180	1.743	3.579	0.005	0.041	0.038	529.443	0.021	0.004
Off-Highway Tractors	2034	100	175	0.147	0.124	0.553	3.135	0.005	0.019	0.017	527.882	0.021	0.004
Off-Highway Tractors	2034	175	300	0.156	0.131	0.553	1.129	0.005	0.024	0.022	527.220	0.021	0.004
Off-Highway Tractors	2034	300	600	0.129	0.108	0.356	1.058	0.005	0.013	0.012	527.324	0.021	0.004
Off-Highway Tractors	2034	600	750	0.238	0.200	0.943	1.115	0.005	0.012	0.011	528.020	0.021	0.004
Off-Highway Tractors	2034	750	999	0.172	0.144	2.518	1.100	0.005	0.025	0.023	527.855	0.021	0.004
Off-Highway Tractors	2035	0	25	4.187	3.518	6.902	9.930	0.005	0.977	0.899	586.774	0.024	0.005
Off-Highway Tractors	2035	25	50	0.419	0.352	3.281	4.516	0.005	0.045	0.041	586.224	0.024	0.005
Off-Highway Tractors	2035	50	75	0.254	0.213	1.926	3.603	0.005	0.061	0.056	526.770	0.021	0.004
Off-Highway Tractors	2035	75	100	0.211	0.177	1.684	3.587	0.005	0.031	0.028	529.330	0.021	0.004
Off-Highway Tractors	2035	100	175	0.143	0.120	0.504	3.134	0.005	0.018	0.017	527.882	0.021	0.004
Off-Highway Tractors	2035	175	300	0.153	0.129	0.529	1.117	0.005	0.022	0.021	527.220	0.021	0.004
Off-Highway Tractors	2035	300	600	0.127	0.107	0.334	1.058	0.005	0.013	0.012	527.324	0.021	0.004
Off-Highway Tractors	2035	600	750	0.238	0.200	0.943	1.115	0.005	0.012	0.011	528.020	0.021	0.004
Off-Highway Tractors	2035	750	999	0.172	0.144	2.518	1.100	0.005	0.025	0.023	527.855	0.021	0.004
Off-Highway Trucks	2025	25	50	0.807	0.678	4.009	5.532	0.005	0.185	0.170	582.022	0.024	0.005
Off-Highway Trucks	2025	50	75	0.278	0.234	1.633	3.905	0.005	0.027	0.024	522.493	0.021	0.004
Off-Highway Trucks	2025	75	100	0.367	0.309	2.692	3.878	0.005	0.156	0.143	530.118	0.022	0.004
Off-Highway Trucks	2025	100	175	0.259	0.218	1.372	3.341	0.005	0.068	0.062	526.643	0.021	0.004
Off-Highway Trucks	2025	175	300	0.222	0.187	1.149	1.234	0.005	0.044	0.041	526.221	0.021	0.004
Off-Highway Trucks	2025	300	600	0.211	0.177	1.086	1.174	0.005	0.038	0.035	528.587	0.021	0.004
Off-Highway Trucks	2025	600	750	0.275	0.231	1.670	1.574	0.005	0.064	0.059	528.690	0.021	0.004
Off-Highway Trucks	2025	750	999	0.201	0.169	2.949	1.134	0.005	0.049	0.045	524.321	0.021	0.004
Off-Highway Trucks	2026	0	25	1.757	1.477	5.626	7.412	0.005	0.540	0.497	586.416	0.024	0.005
Off-Highway Trucks	2026	25	50	0.642	0.539	3.630	5.173	0.005	0.110	0.102	582.867	0.024	0.005
Off-Highway Trucks	2026	50	75	0.290	0.244	1.896	3.952	0.005	0.042	0.039	536.370	0.022	0.004
Off-Highway Trucks	2026	75	100	0.316	0.266	2.294	3.767	0.005	0.114	0.105	526.275	0.021	0.004
Off-Highway Trucks	2026	100	175	0.238	0.200	1.141	3.339	0.005	0.056	0.052	526.869	0.021	0.004
Off-Highway Trucks	2026	175	300	0.218	0.184	1.063	1.220	0.005	0.041	0.038	526.158	0.021	0.004
Off-Highway Trucks	2026	300	600	0.209	0.176	1.011	1.178	0.005	0.036	0.033	529.168	0.021	0.004
Off-Highway Trucks	2026	600	750	0.281	0.236	1.660	1.589	0.005	0.064	0.059	528.767	0.021	0.004
Off-Highway Trucks	2026	750	999	0.202	0.170	2.902	1.126	0.005	0.047	0.043	523.660	0.021	0.004
Off-Highway Trucks	2027	25	50	0.627	0.527	3.647	5.304	0.005	0.104	0.096	582.973	0.024	0.005
Off-Highway Trucks	2027	50	75	0.302	0.254	1.787	4.028	0.005	0.035	0.032	533.289	0.022	0.004
Off-Highway Trucks	2027	75	100	0.307	0.258	2.216	3.742	0.005	0.108	0.100	524.222	0.021	0.004
Off-Highway Trucks	2027	100	175	0.231	0.194	1.062	3.351	0.005	0.053	0.049	526.909	0.021	0.004
Off-Highway Trucks	2027	175	300	0.218	0.183	1.025	1.229	0.005	0.039	0.036	526.197	0.021	0.004
Off-Highway Trucks	2027	300	600	0.210	0.176	0.965	1.179	0.005	0.034	0.031	529.010	0.021	0.004
Off-Highway Trucks	2027	600	750	0.274	0.230	1.539	1.499	0.005	0.058	0.053	528.890	0.021	0.004
Off-Highway Trucks	2027	750	999	0.200	0.168	2.830	1.116	0.005	0.044	0.040	522.477	0.021	0.004
Off-Highway Trucks	2028	0	25	0.608	0.511	4.320	5.199	0.005	0.263	0.242	586.510	0.024	0.005
Off-Highway Trucks	2028	25	50	0.608	0.511	3.536	5.392	0.005	0.074	0.068	582.066	0.024	0.005
Off-Highway Trucks	2028	50	75	0.274	0.230	1.727	3.901	0.005	0.032	0.029	530.814	0.022	0.004
Off-Highway Trucks	2028	75	100	0.308	0.258	2.174	3.777	0.005	0.100	0.092	524.849	0.021	0.004
Off-Highway Trucks	2028	100	175	0.219	0.184	0.919	3.351	0.005	0.046	0.042	526.904	0.021	0.004
Off-Highway Trucks	2028	175	300	0.217	0.182	0.984	1.230	0.005	0.038	0.035	526.165	0.021	0.004
Off-Highway Trucks	2028	300	600	0.208	0.174	0.889	1.170	0.005	0.032	0.029	529.297	0.021	0.004
Off-Highway Trucks	2028	600	750	0.278	0.234	1.559	1.508	0.005	0.059	0.054	528.811	0.021	0.004
Off-Highway Trucks	2028	750	999	0.192	0.162	2.750	1.103	0.005	0.040	0.037	520.748	0.021	0.004
Off-Highway Trucks	2029	0	25	0.839	0.705	5.120	6.252	0.005	0.401	0.369	586.499	0.024	0.005
Off-Highway Trucks	2029	25	50	0.618	0.520	3.512	5.496	0.005	0.065	0.059	582.048	0.024	0.005
Off-Highway Trucks	2029	50	75	0.186	0.156	1.444	3.568	0.005	0.014	0.013	529.963	0.021	0.004

Unmitigated EFs from Caleemod 2022 (based on OFFROAD 2017) Appx G, Table G-11

Equipment	Year	Low HP	High HP	TOG	ROG	NOX	CO	SO2	PM10	PM2.5	CO2	CH4	N2O
Off-Highway Trucks	2029	75	100	0.325	0.273	2.223	3.858	0.005	0.104	0.096	527.522	0.021	0.004
Off-Highway Trucks	2029	100	175	0.208	0.175	0.801	3.352	0.005	0.040	0.037	527.041	0.021	0.004
Off-Highway Trucks	2029	175	300	0.218	0.183	0.983	1.233	0.005	0.038	0.035	526.347	0.021	0.004
Off-Highway Trucks	2029	300	600	0.204	0.172	0.823	1.155	0.005	0.029	0.027	529.508	0.021	0.004
Off-Highway Trucks	2029	600	750	0.267	0.224	1.440	1.431	0.005	0.053	0.049	528.893	0.021	0.004
Off-Highway Trucks	2029	750	999	0.187	0.157	2.673	1.102	0.005	0.036	0.033	520.954	0.021	0.004
Off-Highway Trucks	2030	0	25	0.601	0.505	5.079	6.027	0.005	0.183	0.169	586.499	0.024	0.005
Off-Highway Trucks	2030	25	50	0.618	0.520	3.512	5.496	0.005	0.065	0.060	582.048	0.024	0.005
Off-Highway Trucks	2030	50	75	0.186	0.156	1.444	3.568	0.005	0.014	0.013	529.963	0.021	0.004
Off-Highway Trucks	2030	75	100	0.324	0.272	2.210	3.858	0.005	0.100	0.092	527.522	0.021	0.004
Off-Highway Trucks	2030	100	175	0.203	0.171	0.737	3.352	0.005	0.037	0.034	527.041	0.021	0.004
Off-Highway Trucks	2030	175	300	0.212	0.178	0.908	1.229	0.005	0.035	0.032	526.347	0.021	0.004
Off-Highway Trucks	2030	300	600	0.201	0.169	0.779	1.151	0.005	0.028	0.026	529.508	0.021	0.004
Off-Highway Trucks	2030	600	750	0.257	0.216	1.269	1.388	0.005	0.051	0.047	528.893	0.021	0.004
Off-Highway Trucks	2030	750	999	0.183	0.153	2.643	1.102	0.005	0.034	0.032	520.954	0.021	0.004
Off-Highway Trucks	2031	0	25	0.601	0.505	5.079	6.027	0.005	0.183	0.169	586.499	0.024	0.005
Off-Highway Trucks	2031	25	50	0.612	0.514	3.511	5.490	0.005	0.059	0.055	582.048	0.024	0.005
Off-Highway Trucks	2031	50	75	0.186	0.156	1.444	3.568	0.005	0.014	0.013	529.963	0.021	0.004
Off-Highway Trucks	2031	75	100	0.321	0.270	2.172	3.858	0.005	0.084	0.077	527.522	0.021	0.004
Off-Highway Trucks	2031	100	175	0.199	0.167	0.683	3.352	0.005	0.035	0.032	527.041	0.021	0.004
Off-Highway Trucks	2031	175	300	0.208	0.175	0.871	1.220	0.005	0.033	0.030	526.347	0.021	0.004
Off-Highway Trucks	2031	300	600	0.199	0.167	0.731	1.149	0.005	0.028	0.025	529.508	0.021	0.004
Off-Highway Trucks	2031	600	750	0.250	0.210	1.171	1.268	0.005	0.049	0.045	528.893	0.021	0.004
Off-Highway Trucks	2031	750	999	0.182	0.153	2.626	1.096	0.005	0.033	0.031	520.954	0.021	0.004
Off-Highway Trucks	2032	0	25	0.601	0.505	5.079	6.027	0.005	0.183	0.169	586.499	0.024	0.005
Off-Highway Trucks	2032	25	50	0.612	0.514	3.475	5.490	0.005	0.056	0.051	582.048	0.024	0.005
Off-Highway Trucks	2032	50	75	0.186	0.156	1.444	3.568	0.005	0.014	0.013	529.963	0.021	0.004
Off-Highway Trucks	2032	75	100	0.315	0.265	2.103	3.858	0.005	0.070	0.064	527.522	0.021	0.004
Off-Highway Trucks	2032	100	175	0.197	0.166	0.660	3.352	0.005	0.034	0.032	527.041	0.021	0.004
Off-Highway Trucks	2032	175	300	0.202	0.169	0.802	1.197	0.005	0.030	0.027	526.347	0.021	0.004
Off-Highway Trucks	2032	300	600	0.198	0.166	0.686	1.149	0.005	0.027	0.024	529.508	0.021	0.004
Off-Highway Trucks	2032	600	750	0.249	0.210	1.102	1.259	0.005	0.049	0.045	528.893	0.021	0.004
Off-Highway Trucks	2032	750	999	0.181	0.152	2.606	1.096	0.005	0.033	0.030	520.954	0.021	0.004
Off-Highway Trucks	2033	0	25	0.601	0.505	5.079	6.027	0.005	0.195	0.179	586.499	0.024	0.005
Off-Highway Trucks	2033	25	50	0.593	0.498	3.421	5.471	0.005	0.048	0.044	582.048	0.024	0.005
Off-Highway Trucks	2033	50	75	0.186	0.156	1.444	3.568	0.005	0.014	0.013	529.963	0.021	0.004
Off-Highway Trucks	2033	75	100	0.311	0.262	2.050	3.858	0.005	0.057	0.052	527.522	0.021	0.004
Off-Highway Trucks	2033	100	175	0.195	0.164	0.623	3.352	0.005	0.033	0.030	527.041	0.021	0.004
Off-Highway Trucks	2033	175	300	0.198	0.166	0.734	1.194	0.005	0.028	0.025	526.347	0.021	0.004
Off-Highway Trucks	2033	300	600	0.196	0.165	0.647	1.148	0.005	0.025	0.023	529.508	0.021	0.004
Off-Highway Trucks	2033	600	750	0.242	0.204	0.985	1.252	0.005	0.043	0.039	528.893	0.021	0.004
Off-Highway Trucks	2033	750	999	0.178	0.149	2.544	1.095	0.005	0.031	0.028	520.954	0.021	0.004
Off-Highway Trucks	2034	0	25	0.601	0.505	5.079	6.027	0.005	0.195	0.179	586.499	0.024	0.005
Off-Highway Trucks	2034	25	50	0.584	0.490	3.416	5.459	0.005	0.047	0.043	582.048	0.024	0.005
Off-Highway Trucks	2034	50	75	0.137	0.115	1.388	3.333	0.005	0.012	0.011	527.144	0.021	0.004
Off-Highway Trucks	2034	75	100	0.302	0.253	1.842	3.872	0.005	0.052	0.047	528.035	0.021	0.004
Off-Highway Trucks	2034	100	175	0.194	0.163	0.599	3.350	0.005	0.033	0.030	527.036	0.021	0.004
Off-Highway Trucks	2034	175	300	0.196	0.165	0.703	1.202	0.005	0.027	0.025	526.352	0.021	0.004
Off-Highway Trucks	2034	300	600	0.193	0.162	0.610	1.143	0.005	0.023	0.021	529.508	0.021	0.004
Off-Highway Trucks	2034	600	750	0.238	0.200	0.916	1.221	0.005	0.038	0.035	528.893	0.021	0.004
Off-Highway Trucks	2034	750	999	0.175	0.147	2.508	1.090	0.005	0.029	0.027	520.954	0.021	0.004
Off-Highway Trucks	2035	0	25	0.601	0.505	3.429	6.027	0.005	0.021	0.019	586.499	0.024	0.005
Off-Highway Trucks	2035	25	50	0.579	0.486	3.414	5.455	0.005	0.046	0.043	582.048	0.024	0.005
Off-Highway Trucks	2035	50	75	0.186	0.156	1.444	3.568	0.005	0.014	0.013	529.963	0.021	0.004
Off-Highway Trucks	2035	75	100	0.295	0.248	1.767	3.858	0.005	0.051	0.047	527.522	0.021	0.004
Off-Highway Trucks	2035	100	175	0.193	0.162	0.590	3.352	0.005	0.030	0.028	527.041	0.021	0.004
Off-Highway Trucks	2035	175	300	0.194	0.163	0.677	1.191	0.005	0.026	0.024	526.347	0.021	0.004
Off-Highway Trucks	2035	300	600	0.192	0.161	0.580	1.140	0.005	0.022	0.020	529.508	0.021	0.004
Off-Highway Trucks	2035	600	750	0.236	0.198	0.899	1.219	0.005	0.036	0.033	528.893	0.021	0.004
Off-Highway Trucks	2035	750	999	0.174	0.146	2.499	1.090	0.005	0.029	0.026	520.954	0.021	0.004
Other Construction Equi	2025	0	25	0.994	0.822	6.237	4.875	0.013	0.242	0.222	848.519	0.034	0.007
Other Construction Equi	2025	25	50	0.901	0.757	4.304	4.872	0.005	0.268	0.246	591.483	0.024	0.005
Other Construction Equi	2025	50	75	1.163	0.978	8.526	4.506	0.005	0.653	0.601	522.348	0.021	0.004
Other Construction Equi	2025	75	100	0.354	0.298	2.891	3.512	0.005	0.172	0.159	527.743	0.021	0.004
Other Construction Equi	2025	100	175	0.283	0.238	2.193	3.147	0.005	0.114	0.105	526.485	0.021	0.004
Other Construction Equi	2025	175	300	0.248	0.208	2.169	1.368	0.005	0.085	0.078	528.599	0.021	0.004

Unmitigated EFs from Caleemod 2022 (based on OFFROAD 2017) Appx G, Table G-11

Equipment	Year	Low HP	High HP	TOG	ROG	NOX	CO	SO2	PM10	PM2.5	CO2	CH4	N2O
Other Construction Equi	2025	300	600	0.186	0.156	1.413	1.269	0.005	0.054	0.049	528.419	0.021	0.004
Other Construction Equi	2025	600	750	0.183	0.154	1.514	1.109	0.005	0.051	0.047	528.780	0.021	0.004
Other Construction Equi	2025	750	999	0.148	0.124	2.711	0.999	0.005	0.045	0.041	527.554	0.021	0.004
Other Construction Equi	2026	0	25	0.994	0.822	6.236	4.875	0.013	0.242	0.222	848.462	0.034	0.007
Other Construction Equi	2026	25	50	0.811	0.681	4.084	4.689	0.005	0.231	0.212	589.469	0.024	0.005
Other Construction Equi	2026	50	75	1.367	1.148	9.822	4.741	0.005	0.756	0.695	522.680	0.021	0.004
Other Construction Equi	2026	75	100	0.335	0.282	2.734	3.504	0.005	0.158	0.145	527.541	0.021	0.004
Other Construction Equi	2026	100	175	0.264	0.221	1.956	3.145	0.005	0.101	0.093	527.138	0.021	0.004
Other Construction Equi	2026	175	300	0.243	0.204	2.048	1.374	0.005	0.081	0.075	529.258	0.021	0.004
Other Construction Equi	2026	300	600	0.177	0.149	1.278	1.239	0.005	0.048	0.044	528.521	0.021	0.004
Other Construction Equi	2026	600	750	0.186	0.156	1.475	1.122	0.005	0.050	0.046	529.144	0.021	0.004
Other Construction Equi	2026	750	999	0.147	0.123	2.713	1.000	0.005	0.044	0.040	527.519	0.021	0.004
Other Construction Equi	2027	0	25	0.994	0.821	6.235	4.874	0.013	0.242	0.222	848.282	0.034	0.007
Other Construction Equi	2027	25	50	0.739	0.621	3.882	4.538	0.005	0.195	0.179	588.146	0.024	0.005
Other Construction Equi	2027	50	75	1.404	1.180	9.930	4.731	0.005	0.781	0.719	524.003	0.021	0.004
Other Construction Equi	2027	75	100	0.300	0.252	2.500	3.484	0.005	0.132	0.122	527.442	0.021	0.004
Other Construction Equi	2027	100	175	0.255	0.214	1.831	3.154	0.005	0.095	0.088	527.759	0.021	0.004
Other Construction Equi	2027	175	300	0.230	0.194	1.797	1.337	0.005	0.074	0.068	529.513	0.021	0.004
Other Construction Equi	2027	300	600	0.174	0.146	1.205	1.245	0.005	0.046	0.042	529.137	0.021	0.004
Other Construction Equi	2027	600	750	0.194	0.163	1.522	1.131	0.005	0.052	0.048	528.713	0.021	0.004
Other Construction Equi	2027	750	999	0.136	0.114	2.655	0.991	0.005	0.040	0.036	527.346	0.021	0.004
Other Construction Equi	2028	0	25	0.994	0.822	6.235	4.874	0.013	0.242	0.222	848.344	0.034	0.007
Other Construction Equi	2028	25	50	0.689	0.579	3.738	4.442	0.005	0.169	0.156	587.292	0.024	0.005
Other Construction Equi	2028	50	75	1.883	1.582	12.421	5.280	0.005	1.004	0.924	525.525	0.021	0.004
Other Construction Equi	2028	75	100	0.291	0.245	2.433	3.486	0.005	0.124	0.114	526.922	0.021	0.004
Other Construction Equi	2028	100	175	0.251	0.211	1.758	3.160	0.005	0.091	0.084	527.154	0.021	0.004
Other Construction Equi	2028	175	300	0.228	0.191	1.686	1.341	0.005	0.072	0.066	529.412	0.021	0.004
Other Construction Equi	2028	300	600	0.170	0.143	1.112	1.250	0.005	0.043	0.040	530.082	0.022	0.004
Other Construction Equi	2028	600	750	0.195	0.164	1.528	1.122	0.005	0.053	0.049	526.876	0.021	0.004
Other Construction Equi	2028	750	999	0.136	0.114	2.661	0.994	0.005	0.038	0.035	527.467	0.021	0.004
Other Construction Equi	2029	0	25	0.994	0.822	6.237	4.875	0.013	0.242	0.222	848.487	0.034	0.007
Other Construction Equi	2029	25	50	0.642	0.539	3.639	4.387	0.005	0.149	0.137	587.712	0.024	0.005
Other Construction Equi	2029	50	75	1.548	1.301	10.418	4.970	0.005	0.837	0.770	529.758	0.021	0.004
Other Construction Equi	2029	75	100	0.285	0.239	2.359	3.493	0.005	0.115	0.106	526.880	0.021	0.004
Other Construction Equi	2029	100	175	0.250	0.210	1.713	3.171	0.005	0.089	0.082	527.014	0.021	0.004
Other Construction Equi	2029	175	300	0.221	0.186	1.531	1.342	0.005	0.068	0.062	529.120	0.021	0.004
Other Construction Equi	2029	300	600	0.172	0.145	1.095	1.246	0.005	0.043	0.039	529.813	0.021	0.004
Other Construction Equi	2029	600	750	0.157	0.132	1.030	1.094	0.005	0.036	0.033	526.727	0.021	0.004
Other Construction Equi	2029	750	999	0.142	0.119	2.675	1.002	0.005	0.039	0.036	527.595	0.021	0.004
Other Construction Equi	2030	0	25	0.994	0.822	6.236	4.875	0.013	0.242	0.222	848.452	0.034	0.007
Other Construction Equi	2030	25	50	0.597	0.501	3.621	4.338	0.005	0.135	0.124	587.712	0.024	0.005
Other Construction Equi	2030	50	75	1.543	1.296	10.442	5.051	0.005	0.826	0.760	530.139	0.022	0.004
Other Construction Equi	2030	75	100	0.278	0.233	2.313	3.489	0.005	0.111	0.102	526.886	0.021	0.004
Other Construction Equi	2030	100	175	0.240	0.202	1.643	3.170	0.005	0.085	0.078	527.014	0.021	0.004
Other Construction Equi	2030	175	300	0.205	0.172	1.406	1.295	0.005	0.059	0.054	529.120	0.021	0.004
Other Construction Equi	2030	300	600	0.165	0.139	1.000	1.246	0.005	0.039	0.036	529.813	0.021	0.004
Other Construction Equi	2030	600	750	0.153	0.129	0.901	1.094	0.005	0.036	0.033	526.727	0.021	0.004
Other Construction Equi	2030	750	999	0.139	0.117	2.655	1.002	0.005	0.037	0.034	527.595	0.021	0.004
Other Construction Equi	2031	0	25	0.994	0.822	6.236	4.875	0.013	0.242	0.222	848.458	0.034	0.007
Other Construction Equi	2031	25	50	0.567	0.476	3.607	4.309	0.005	0.126	0.116	587.712	0.024	0.005
Other Construction Equi	2031	50	75	1.483	1.246	9.596	4.829	0.005	0.809	0.744	529.758	0.021	0.004
Other Construction Equi	2031	75	100	0.256	0.215	2.155	3.476	0.005	0.097	0.089	526.880	0.021	0.004
Other Construction Equi	2031	100	175	0.232	0.195	1.509	3.170	0.005	0.081	0.074	527.014	0.021	0.004
Other Construction Equi	2031	175	300	0.201	0.169	1.348	1.289	0.005	0.057	0.052	529.120	0.021	0.004
Other Construction Equi	2031	300	600	0.163	0.137	0.952	1.246	0.005	0.038	0.035	529.813	0.021	0.004
Other Construction Equi	2031	600	750	0.150	0.126	0.776	1.094	0.005	0.033	0.031	526.727	0.021	0.004
Other Construction Equi	2031	750	999	0.138	0.116	2.640	1.002	0.005	0.037	0.034	527.595	0.021	0.004
Other Construction Equi	2032	0	25	0.994	0.822	6.236	4.875	0.013	0.242	0.222	848.435	0.034	0.007
Other Construction Equi	2032	25	50	0.542	0.456	3.578	4.281	0.005	0.115	0.106	587.712	0.024	0.005
Other Construction Equi	2032	50	75	1.483	1.246	9.596	4.829	0.005	0.809	0.744	529.758	0.021	0.004
Other Construction Equi	2032	75	100	0.243	0.204	2.078	3.467	0.005	0.089	0.082	526.880	0.021	0.004
Other Construction Equi	2032	100	175	0.223	0.187	1.390	3.163	0.005	0.076	0.070	527.014	0.021	0.004
Other Construction Equi	2032	175	300	0.195	0.164	1.274	1.275	0.005	0.052	0.048	529.120	0.021	0.004
Other Construction Equi	2032	300	600	0.159	0.133	0.890	1.246	0.005	0.035	0.032	529.813	0.021	0.004
Other Construction Equi	2032	600	750	0.149	0.126	0.767	1.094	0.005	0.032	0.030	526.727	0.021	0.004
Other Construction Equi	2032	750	999	0.126	0.105	2.509	1.002	0.005	0.032	0.029	527.595	0.021	0.004
Other Construction Equi	2033	0	25	0.994	0.822	6.236	4.875	0.013	0.242	0.222	848.403	0.034	0.007
Other Construction Equi	2033	25	50	0.510	0.428	3.551	4.248	0.005	0.106	0.097	587.712	0.024	0.005

Unmitigated EFs from Caleemod 2022 (based on OFFROAD 2017) Appx G, Table G-11

Equipment	Year	Low HP	High HP	TOG	ROG	NOX	CO	SO2	PM10	PM2.5	CO2	CH4	N2O
Other Construction Equi	2033	50	75	1.441	1.211	9.086	4.730	0.005	0.792	0.729	529.758	0.021	0.004
Other Construction Equi	2033	75	100	0.228	0.192	1.998	3.460	0.005	0.078	0.072	526.880	0.021	0.004
Other Construction Equi	2033	100	175	0.218	0.183	1.344	3.157	0.005	0.069	0.064	527.014	0.021	0.004
Other Construction Equi	2033	175	300	0.190	0.160	1.206	1.265	0.005	0.049	0.045	529.120	0.021	0.004
Other Construction Equi	2033	300	600	0.155	0.130	0.823	1.239	0.005	0.033	0.030	529.813	0.021	0.004
Other Construction Equi	2033	600	750	0.143	0.120	0.687	1.094	0.005	0.024	0.022	526.727	0.021	0.004
Other Construction Equi	2033	750	999	0.126	0.105	2.365	1.002	0.005	0.027	0.025	527.595	0.021	0.004
Other Construction Equi	2034	0	25	0.994	0.822	6.235	4.874	0.013	0.242	0.222	848.344	0.034	0.007
Other Construction Equi	2034	25	50	0.478	0.401	3.478	4.214	0.005	0.094	0.086	587.712	0.024	0.005
Other Construction Equi	2034	50	75	1.397	1.174	8.861	4.765	0.005	0.752	0.692	530.139	0.022	0.004
Other Construction Equi	2034	75	100	0.226	0.190	1.985	3.460	0.005	0.076	0.070	526.886	0.021	0.004
Other Construction Equi	2034	100	175	0.213	0.179	1.290	3.154	0.005	0.064	0.059	527.014	0.021	0.004
Other Construction Equi	2034	175	300	0.188	0.158	1.157	1.265	0.005	0.048	0.044	529.120	0.021	0.004
Other Construction Equi	2034	300	600	0.152	0.128	0.768	1.235	0.005	0.029	0.027	529.813	0.021	0.004
Other Construction Equi	2034	600	750	0.140	0.118	0.649	1.094	0.005	0.024	0.022	526.727	0.021	0.004
Other Construction Equi	2034	750	999	0.126	0.105	2.365	1.002	0.005	0.027	0.025	527.595	0.021	0.004
Other Construction Equi	2035	0	25	0.994	0.822	6.236	4.875	0.013	0.242	0.222	848.379	0.034	0.007
Other Construction Equi	2035	25	50	0.455	0.382	3.396	4.189	0.005	0.082	0.075	587.712	0.024	0.005
Other Construction Equi	2035	50	75	1.414	1.188	8.686	4.702	0.005	0.791	0.728	529.758	0.021	0.004
Other Construction Equi	2035	75	100	0.208	0.175	1.885	3.450	0.005	0.059	0.055	526.880	0.021	0.004
Other Construction Equi	2035	100	175	0.207	0.174	1.244	3.154	0.005	0.061	0.056	527.014	0.021	0.004
Other Construction Equi	2035	175	300	0.185	0.156	1.109	1.264	0.005	0.047	0.044	529.120	0.021	0.004
Other Construction Equi	2035	300	600	0.147	0.124	0.715	1.222	0.005	0.027	0.025	529.813	0.021	0.004
Other Construction Equi	2035	600	750	0.135	0.114	0.584	1.094	0.005	0.019	0.018	526.727	0.021	0.004
Other Construction Equi	2035	750	999	0.126	0.105	2.365	1.002	0.005	0.027	0.025	527.595	0.021	0.004
Other General Industrial	2025	0	25	0.992	0.820	6.400	3.898	0.011	0.242	0.223	848.007	0.034	0.007
Other General Industrial	2025	25	50	0.585	0.491	3.713	4.675	0.005	0.136	0.125	588.026	0.024	0.005
Other General Industrial	2025	50	75	0.246	0.207	2.050	3.571	0.005	0.077	0.071	528.191	0.021	0.004
Other General Industrial	2025	75	100	0.526	0.442	3.866	3.825	0.005	0.270	0.248	528.455	0.021	0.004
Other General Industrial	2025	100	175	0.237	0.199	1.445	3.226	0.005	0.076	0.070	528.383	0.021	0.004
Other General Industrial	2025	175	300	0.204	0.172	1.397	1.167	0.005	0.047	0.043	528.509	0.021	0.004
Other General Industrial	2025	300	600	0.168	0.141	0.875	1.087	0.005	0.030	0.027	528.188	0.021	0.004
Other General Industrial	2025	600	750	0.122	0.102	0.535	1.209	0.005	0.025	0.023	528.187	0.021	0.004
Other General Industrial	2025	750	999	0.188	0.158	3.301	1.046	0.005	0.055	0.051	528.190	0.021	0.004
Other General Industrial	2026	0	25	0.992	0.820	6.401	3.899	0.011	0.242	0.223	848.083	0.034	0.007
Other General Industrial	2026	25	50	0.540	0.453	3.588	4.594	0.005	0.113	0.104	587.877	0.024	0.005
Other General Industrial	2026	50	75	0.249	0.209	2.089	3.579	0.005	0.078	0.072	528.133	0.021	0.004
Other General Industrial	2026	75	100	0.404	0.340	2.844	3.749	0.005	0.167	0.153	529.857	0.021	0.004
Other General Industrial	2026	100	175	0.229	0.192	1.349	3.225	0.005	0.070	0.064	528.383	0.021	0.004
Other General Industrial	2026	175	300	0.194	0.163	1.192	1.166	0.005	0.041	0.037	528.627	0.021	0.004
Other General Industrial	2026	300	600	0.164	0.138	0.786	1.090	0.005	0.026	0.024	528.188	0.021	0.004
Other General Industrial	2026	600	750	0.109	0.091	0.532	1.190	0.005	0.024	0.022	528.187	0.021	0.004
Other General Industrial	2026	750	999	0.196	0.164	3.319	1.057	0.005	0.056	0.051	528.190	0.021	0.004
Other General Industrial	2027	0	25	0.992	0.820	6.400	3.898	0.011	0.242	0.223	847.999	0.034	0.007
Other General Industrial	2027	25	50	0.519	0.436	3.525	4.597	0.005	0.099	0.091	587.927	0.024	0.005
Other General Industrial	2027	50	75	0.243	0.204	1.968	3.582	0.005	0.068	0.063	528.439	0.021	0.004
Other General Industrial	2027	75	100	0.358	0.301	2.610	3.728	0.005	0.131	0.120	528.727	0.021	0.004
Other General Industrial	2027	100	175	0.215	0.181	1.192	3.213	0.005	0.061	0.056	528.408	0.021	0.004
Other General Industrial	2027	175	300	0.185	0.155	1.049	1.166	0.005	0.037	0.034	528.632	0.021	0.004
Other General Industrial	2027	300	600	0.168	0.141	0.767	1.098	0.005	0.025	0.023	528.188	0.021	0.004
Other General Industrial	2027	600	750	0.109	0.092	0.515	1.179	0.005	0.023	0.021	528.187	0.021	0.004
Other General Industrial	2027	750	999	0.203	0.171	3.336	1.069	0.005	0.056	0.052	528.190	0.021	0.004
Other General Industrial	2028	0	25	0.992	0.820	6.400	3.898	0.011	0.242	0.223	847.980	0.034	0.007
Other General Industrial	2028	25	50	0.487	0.409	3.447	4.548	0.005	0.084	0.077	587.798	0.024	0.005
Other General Industrial	2028	50	75	0.223	0.187	1.772	3.566	0.005	0.049	0.045	528.164	0.021	0.004
Other General Industrial	2028	75	100	0.398	0.335	2.847	3.824	0.005	0.157	0.144	529.430	0.021	0.004
Other General Industrial	2028	100	175	0.206	0.173	1.066	3.206	0.005	0.054	0.050	528.484	0.021	0.004
Other General Industrial	2028	175	300	0.191	0.161	1.051	1.178	0.005	0.037	0.034	528.632	0.021	0.004
Other General Industrial	2028	300	600	0.165	0.139	0.709	1.098	0.005	0.024	0.022	528.188	0.021	0.004
Other General Industrial	2028	600	750	0.122	0.102	0.574	1.237	0.005	0.027	0.025	528.186	0.021	0.004
Other General Industrial	2028	750	999	0.187	0.157	3.298	1.044	0.005	0.055	0.051	528.190	0.021	0.004
Other General Industrial	2029	0	25	0.989	0.818	6.399	3.893	0.011	0.242	0.222	848.256	0.034	0.007
Other General Industrial	2029	25	50	0.468	0.393	3.404	4.541	0.005	0.074	0.068	587.815	0.024	0.005
Other General Industrial	2029	50	75	0.227	0.190	1.779	3.563	0.005	0.051	0.047	528.465	0.021	0.004
Other General Industrial	2029	75	100	0.364	0.306	2.536	3.845	0.005	0.122	0.112	528.993	0.021	0.004
Other General Industrial	2029	100	175	0.194	0.163	0.974	3.179	0.005	0.049	0.045	528.484	0.021	0.004

Unmitigated EFs from Caleemod 2022 (based on OFFROAD 2017) Appx G, Table G-11

Equipment	Year	Low HP	High HP	TOG	ROG	NOX	CO	SO2	PM10	PM2.5	CO2	CH4	N2O
Other General Industrial	2029	175	300	0.188	0.158	0.941	1.187	0.005	0.033	0.030	528.265	0.021	0.004
Other General Industrial	2029	300	600	0.157	0.132	0.651	1.093	0.005	0.022	0.020	528.188	0.021	0.004
Other General Industrial	2029	600	750	0.117	0.099	0.554	1.217	0.005	0.026	0.024	528.186	0.021	0.004
Other General Industrial	2029	750	999	0.194	0.163	3.315	1.055	0.005	0.056	0.051	528.190	0.021	0.004
Other General Industrial	2030	0	25	0.992	0.820	6.400	3.899	0.011	0.242	0.223	848.027	0.034	0.007
Other General Industrial	2030	25	50	0.448	0.377	3.380	4.522	0.005	0.064	0.059	587.815	0.024	0.005
Other General Industrial	2030	50	75	0.219	0.184	1.760	3.555	0.005	0.047	0.044	528.426	0.021	0.004
Other General Industrial	2030	75	100	0.341	0.287	2.338	3.833	0.005	0.105	0.097	528.993	0.021	0.004
Other General Industrial	2030	100	175	0.188	0.158	0.903	3.179	0.005	0.047	0.043	528.484	0.021	0.004
Other General Industrial	2030	175	300	0.181	0.153	0.824	1.187	0.005	0.032	0.030	528.265	0.021	0.004
Other General Industrial	2030	300	600	0.151	0.127	0.595	1.086	0.005	0.020	0.019	528.188	0.021	0.004
Other General Industrial	2030	600	750	0.111	0.093	0.557	1.236	0.005	0.024	0.022	528.186	0.021	0.004
Other General Industrial	2030	750	999	0.183	0.154	2.893	1.050	0.005	0.049	0.045	528.190	0.021	0.004
Other General Industrial	2031	0	25	0.992	0.820	6.400	3.898	0.011	0.242	0.223	847.970	0.034	0.007
Other General Industrial	2031	25	50	0.434	0.365	3.369	4.506	0.005	0.059	0.054	587.815	0.024	0.005
Other General Industrial	2031	50	75	0.216	0.181	1.746	3.551	0.005	0.046	0.042	528.426	0.021	0.004
Other General Industrial	2031	75	100	0.324	0.272	2.170	3.826	0.005	0.090	0.082	528.993	0.021	0.004
Other General Industrial	2031	100	175	0.183	0.154	0.843	3.168	0.005	0.044	0.040	528.484	0.021	0.004
Other General Industrial	2031	175	300	0.176	0.148	0.738	1.186	0.005	0.029	0.027	528.265	0.021	0.004
Other General Industrial	2031	300	600	0.149	0.125	0.547	1.086	0.005	0.020	0.019	528.188	0.021	0.004
Other General Industrial	2031	600	750	0.112	0.094	0.533	1.217	0.005	0.023	0.021	528.186	0.021	0.004
Other General Industrial	2031	750	999	0.194	0.163	3.315	1.055	0.005	0.056	0.051	528.190	0.021	0.004
Other General Industrial	2032	0	25	0.992	0.820	6.400	3.899	0.011	0.242	0.223	847.980	0.034	0.007
Other General Industrial	2032	25	50	0.418	0.351	3.347	4.490	0.005	0.054	0.049	587.815	0.024	0.005
Other General Industrial	2032	50	75	0.205	0.172	1.665	3.540	0.005	0.038	0.035	528.212	0.021	0.004
Other General Industrial	2032	75	100	0.322	0.271	2.143	3.835	0.005	0.092	0.084	529.545	0.021	0.004
Other General Industrial	2032	100	175	0.178	0.149	0.768	3.168	0.005	0.041	0.038	528.484	0.021	0.004
Other General Industrial	2032	175	300	0.174	0.146	0.717	1.177	0.005	0.028	0.026	528.265	0.021	0.004
Other General Industrial	2032	300	600	0.148	0.124	0.513	1.086	0.005	0.020	0.018	528.188	0.021	0.004
Other General Industrial	2032	600	750	0.109	0.091	0.512	1.217	0.005	0.021	0.019	528.186	0.021	0.004
Other General Industrial	2032	750	999	0.194	0.163	3.315	1.055	0.005	0.056	0.051	528.190	0.021	0.004
Other General Industrial	2033	0	25	0.992	0.820	6.400	3.899	0.011	0.242	0.223	848.020	0.034	0.007
Other General Industrial	2033	25	50	0.408	0.343	3.317	4.479	0.005	0.047	0.044	587.815	0.024	0.005
Other General Industrial	2033	50	75	0.205	0.172	1.645	3.544	0.005	0.036	0.033	528.426	0.021	0.004
Other General Industrial	2033	75	100	0.304	0.255	2.024	3.816	0.005	0.080	0.074	528.993	0.021	0.004
Other General Industrial	2033	100	175	0.175	0.147	0.748	3.167	0.005	0.037	0.034	528.484	0.021	0.004
Other General Industrial	2033	175	300	0.174	0.146	0.684	1.177	0.005	0.028	0.026	528.265	0.021	0.004
Other General Industrial	2033	300	600	0.146	0.123	0.487	1.086	0.005	0.019	0.017	528.188	0.021	0.004
Other General Industrial	2033	600	750	0.109	0.091	0.512	1.217	0.005	0.021	0.019	528.186	0.021	0.004
Other General Industrial	2033	750	999	0.188	0.158	3.013	1.055	0.005	0.048	0.045	528.190	0.021	0.004
Other General Industrial	2034	0	25	0.993	0.820	6.401	3.899	0.011	0.242	0.223	848.133	0.034	0.007
Other General Industrial	2034	25	50	0.400	0.336	3.275	4.472	0.005	0.041	0.038	587.815	0.024	0.005
Other General Industrial	2034	50	75	0.204	0.171	1.638	3.543	0.005	0.036	0.033	528.426	0.021	0.004
Other General Industrial	2034	75	100	0.299	0.252	1.963	3.814	0.005	0.073	0.067	528.993	0.021	0.004
Other General Industrial	2034	100	175	0.169	0.142	0.699	3.167	0.005	0.031	0.028	528.484	0.021	0.004
Other General Industrial	2034	175	300	0.168	0.141	0.614	1.142	0.005	0.025	0.023	528.265	0.021	0.004
Other General Industrial	2034	300	600	0.144	0.121	0.469	1.086	0.005	0.018	0.016	528.188	0.021	0.004
Other General Industrial	2034	600	750	0.109	0.091	0.512	1.217	0.005	0.021	0.019	528.186	0.021	0.004
Other General Industrial	2034	750	999	0.185	0.155	2.911	1.055	0.005	0.046	0.042	528.190	0.021	0.004
Other General Industrial	2035	0	25	0.992	0.820	6.400	3.899	0.011	0.242	0.223	848.001	0.034	0.007
Other General Industrial	2035	25	50	0.395	0.332	3.229	4.466	0.005	0.036	0.033	587.815	0.024	0.005
Other General Industrial	2035	50	75	0.203	0.171	1.635	3.542	0.005	0.034	0.031	528.426	0.021	0.004
Other General Industrial	2035	75	100	0.282	0.237	1.870	3.807	0.005	0.057	0.053	528.993	0.021	0.004
Other General Industrial	2035	100	175	0.165	0.139	0.667	3.167	0.005	0.029	0.026	528.484	0.021	0.004
Other General Industrial	2035	175	300	0.166	0.140	0.578	1.142	0.005	0.024	0.022	528.265	0.021	0.004
Other General Industrial	2035	300	600	0.143	0.121	0.462	1.084	0.005	0.018	0.016	528.188	0.021	0.004
Other General Industrial	2035	600	750	0.109	0.091	0.512	1.217	0.005	0.021	0.019	528.186	0.021	0.004
Other General Industrial	2035	750	999	0.184	0.155	2.860	1.055	0.005	0.046	0.042	528.190	0.021	0.004
Other Material Handling	2025	0	25	1.430	1.202	4.143	5.824	0.005	0.296	0.272	586.785	0.024	0.005
Other Material Handling	2025	25	50	0.866	0.728	4.268	5.259	0.005	0.238	0.219	590.076	0.024	0.005
Other Material Handling	2025	50	75	0.632	0.531	4.560	4.133	0.005	0.364	0.335	525.353	0.021	0.004
Other Material Handling	2025	75	100	0.218	0.183	1.957	3.456	0.005	0.066	0.060	528.778	0.021	0.004
Other Material Handling	2025	100	175	0.248	0.209	1.552	3.239	0.005	0.086	0.079	527.405	0.021	0.004
Other Material Handling	2025	175	300	0.286	0.240	2.021	1.176	0.005	0.083	0.076	528.011	0.021	0.004
Other Material Handling	2025	300	600	0.199	0.167	1.280	1.263	0.005	0.048	0.044	528.583	0.021	0.004
Other Material Handling	2025	600	750	0.406	0.341	2.673	1.132	0.005	0.140	0.129	527.804	0.021	0.004

Unmitigated EFs from Caleemod 2022 (based on OFFROAD 2017) Appx G, Table G-11

Equipment	Year	Low HP	High HP	TOG	ROG	NOX	CO	SO2	PM10	PM2.5	CO2	CH4	N2O
Other Material Handling	2025	750	999	0.072	0.061	2.284	0.950	0.005	0.018	0.017	527.804	0.021	0.004
Other Material Handling	2026	0	25	1.444	1.213	4.161	5.915	0.005	0.296	0.272	586.785	0.024	0.005
Other Material Handling	2026	25	50	0.858	0.721	4.190	5.272	0.005	0.219	0.201	590.076	0.024	0.005
Other Material Handling	2026	50	75	0.641	0.539	4.573	4.161	0.005	0.366	0.337	525.353	0.021	0.004
Other Material Handling	2026	75	100	0.211	0.177	1.906	3.450	0.005	0.060	0.055	528.736	0.021	0.004
Other Material Handling	2026	100	175	0.251	0.211	1.510	3.262	0.005	0.084	0.077	527.402	0.021	0.004
Other Material Handling	2026	175	300	0.285	0.239	1.961	1.159	0.005	0.081	0.074	528.000	0.021	0.004
Other Material Handling	2026	300	600	0.165	0.138	0.923	1.163	0.005	0.031	0.029	527.861	0.021	0.004
Other Material Handling	2026	600	750	0.242	0.203	1.470	1.042	0.005	0.075	0.069	527.804	0.021	0.004
Other Material Handling	2026	750	999	0.081	0.068	2.305	0.963	0.005	0.019	0.018	527.804	0.021	0.004
Other Material Handling	2027	0	25	2.464	2.070	5.188	7.688	0.005	0.544	0.501	586.799	0.024	0.005
Other Material Handling	2027	25	50	0.706	0.593	3.993	5.007	0.005	0.174	0.160	590.004	0.024	0.005
Other Material Handling	2027	50	75	0.738	0.620	5.178	4.246	0.005	0.420	0.386	527.825	0.021	0.004
Other Material Handling	2027	75	100	0.210	0.176	1.853	3.460	0.005	0.056	0.051	528.708	0.021	0.004
Other Material Handling	2027	100	175	0.225	0.189	1.295	3.259	0.005	0.064	0.059	527.568	0.021	0.004
Other Material Handling	2027	175	300	0.278	0.234	1.809	1.161	0.005	0.077	0.071	528.104	0.021	0.004
Other Material Handling	2027	300	600	0.166	0.140	0.903	1.167	0.005	0.031	0.029	527.861	0.021	0.004
Other Material Handling	2027	600	750	0.246	0.207	1.471	1.048	0.005	0.075	0.069	527.804	0.021	0.004
Other Material Handling	2027	750	999	0.090	0.075	2.325	0.976	0.005	0.020	0.018	527.804	0.021	0.004
Other Material Handling	2028	0	25	2.477	2.081	5.206	7.773	0.005	0.544	0.501	586.799	0.024	0.005
Other Material Handling	2028	25	50	0.576	0.484	3.683	4.648	0.005	0.129	0.119	588.708	0.024	0.005
Other Material Handling	2028	50	75	0.591	0.496	4.285	4.187	0.005	0.332	0.306	527.829	0.021	0.004
Other Material Handling	2028	75	100	0.207	0.174	1.789	3.479	0.005	0.050	0.046	528.459	0.021	0.004
Other Material Handling	2028	100	175	0.206	0.173	1.094	3.245	0.005	0.053	0.049	527.705	0.021	0.004
Other Material Handling	2028	175	300	0.262	0.220	1.608	1.164	0.005	0.068	0.063	528.007	0.021	0.004
Other Material Handling	2028	300	600	0.156	0.131	0.745	1.158	0.005	0.026	0.024	527.857	0.021	0.004
Other Material Handling	2028	600	750	0.250	0.210	1.473	1.054	0.005	0.075	0.069	527.804	0.021	0.004
Other Material Handling	2028	750	999	0.098	0.082	2.345	0.989	0.005	0.020	0.019	527.804	0.021	0.004
Other Material Handling	2029	0	25	1.608	1.351	5.439	7.004	0.005	0.408	0.375	586.785	0.024	0.005
Other Material Handling	2029	25	50	0.547	0.460	3.473	4.496	0.005	0.106	0.097	588.751	0.024	0.005
Other Material Handling	2029	50	75	0.682	0.573	4.858	4.272	0.005	0.378	0.348	527.842	0.021	0.004
Other Material Handling	2029	75	100	0.214	0.180	1.786	3.513	0.005	0.049	0.045	528.611	0.021	0.004
Other Material Handling	2029	100	175	0.203	0.171	1.038	3.258	0.005	0.049	0.045	527.812	0.021	0.004
Other Material Handling	2029	175	300	0.246	0.207	1.449	1.169	0.005	0.059	0.054	528.016	0.021	0.004
Other Material Handling	2029	300	600	0.156	0.131	0.727	1.157	0.005	0.025	0.023	527.856	0.021	0.004
Other Material Handling	2029	600	750	0.090	0.076	0.267	0.978	0.005	0.010	0.009	527.804	0.021	0.004
Other Material Handling	2029	750	999	0.092	0.077	2.330	0.980	0.005	0.020	0.018	527.804	0.021	0.004
Other Material Handling	2030	0	25	1.608	1.351	5.439	7.004	0.005	0.408	0.375	586.785	0.024	0.005
Other Material Handling	2030	25	50	0.523	0.440	3.405	4.474	0.005	0.088	0.081	588.751	0.024	0.005
Other Material Handling	2030	50	75	0.682	0.573	4.858	4.272	0.005	0.391	0.360	527.842	0.021	0.004
Other Material Handling	2030	75	100	0.204	0.172	1.728	3.506	0.005	0.042	0.039	528.611	0.021	0.004
Other Material Handling	2030	100	175	0.197	0.166	0.973	3.255	0.005	0.046	0.042	527.812	0.021	0.004
Other Material Handling	2030	175	300	0.240	0.202	1.378	1.160	0.005	0.058	0.053	528.016	0.021	0.004
Other Material Handling	2030	300	600	0.154	0.129	0.651	1.132	0.005	0.024	0.022	527.856	0.021	0.004
Other Material Handling	2030	600	750	0.090	0.076	0.267	0.978	0.005	0.010	0.009	527.804	0.021	0.004
Other Material Handling	2030	750	999	0.092	0.077	2.330	0.980	0.005	0.020	0.018	527.804	0.021	0.004
Other Material Handling	2031	25	50	0.489	0.411	3.434	4.493	0.005	0.081	0.075	588.672	0.024	0.005
Other Material Handling	2031	50	75	0.841	0.707	4.302	4.537	0.005	0.294	0.270	531.356	0.022	0.004
Other Material Handling	2031	75	100	0.199	0.168	1.671	3.504	0.005	0.038	0.035	528.611	0.021	0.004
Other Material Handling	2031	100	175	0.194	0.163	0.948	3.254	0.005	0.042	0.039	527.812	0.021	0.004
Other Material Handling	2031	175	300	0.235	0.197	1.286	1.160	0.005	0.057	0.052	528.016	0.021	0.004
Other Material Handling	2031	300	600	0.151	0.126	0.611	1.132	0.005	0.024	0.022	527.856	0.021	0.004
Other Material Handling	2031	600	750	0.090	0.076	0.267	0.978	0.005	0.010	0.009	527.804	0.021	0.004
Other Material Handling	2031	750	999	0.092	0.077	2.330	0.980	0.005	0.020	0.018	527.804	0.021	0.004
Other Material Handling	2032	0	25	1.608	1.351	4.913	7.004	0.005	0.356	0.327	586.785	0.024	0.005
Other Material Handling	2032	25	50	0.447	0.376	3.387	4.400	0.005	0.072	0.067	588.751	0.024	0.005
Other Material Handling	2032	50	75	0.589	0.495	4.089	4.119	0.005	0.246	0.226	527.842	0.021	0.004
Other Material Handling	2032	75	100	0.193	0.162	1.628	3.502	0.005	0.033	0.031	528.611	0.021	0.004
Other Material Handling	2032	100	175	0.188	0.158	0.878	3.246	0.005	0.039	0.036	527.812	0.021	0.004
Other Material Handling	2032	175	300	0.212	0.178	1.015	1.155	0.005	0.031	0.029	528.016	0.021	0.004
Other Material Handling	2032	300	600	0.148	0.124	0.580	1.132	0.005	0.024	0.022	527.856	0.021	0.004
Other Material Handling	2032	600	750	0.090	0.076	0.267	0.978	0.005	0.010	0.009	527.804	0.021	0.004
Other Material Handling	2032	750	999	0.092	0.077	2.330	0.980	0.005	0.020	0.018	527.804	0.021	0.004
Other Material Handling	2033	0	25	1.159	0.974	4.787	6.570	0.005	0.295	0.271	586.785	0.024	0.005
Other Material Handling	2033	25	50	0.432	0.363	3.384	4.386	0.005	0.066	0.061	588.751	0.024	0.005
Other Material Handling	2033	50	75	0.589	0.495	3.920	4.119	0.005	0.184	0.170	527.842	0.021	0.004
Other Material Handling	2033	75	100	0.190	0.160	1.599	3.501	0.005	0.031	0.029	528.611	0.021	0.004
Other Material Handling	2033	100	175	0.185	0.155	0.843	3.246	0.005	0.037	0.034	527.812	0.021	0.004

Unmitigated EFs from Caleemod 2022 (based on OFFROAD 2017) Appx G, Table G-11

Equipment	Year	Low HP	High HP	TOG	ROG	NOX	CO	SO2	PM10	PM2.5	CO2	CH4	N2O
Other Material Handling	2033	175	300	0.206	0.173	0.964	1.146	0.005	0.025	0.023	528.024	0.021	0.004
Other Material Handling	2033	300	600	0.147	0.124	0.553	1.131	0.005	0.023	0.022	527.855	0.021	0.004
Other Material Handling	2033	600	750	0.090	0.076	0.267	0.978	0.005	0.010	0.009	527.804	0.021	0.004
Other Material Handling	2033	750	999	0.092	0.077	2.330	0.980	0.005	0.020	0.018	527.804	0.021	0.004
Other Material Handling	2034	0	25	1.009	0.848	4.236	6.426	0.005	0.220	0.203	586.785	0.024	0.005
Other Material Handling	2034	25	50	0.432	0.363	3.384	4.386	0.005	0.066	0.061	588.751	0.024	0.005
Other Material Handling	2034	50	75	0.513	0.431	2.891	4.119	0.005	0.184	0.170	527.842	0.021	0.004
Other Material Handling	2034	75	100	0.189	0.159	1.583	3.500	0.005	0.030	0.028	528.611	0.021	0.004
Other Material Handling	2034	100	175	0.177	0.149	0.788	3.244	0.005	0.034	0.031	527.812	0.021	0.004
Other Material Handling	2034	175	300	0.202	0.170	0.901	1.139	0.005	0.024	0.022	528.016	0.021	0.004
Other Material Handling	2034	300	600	0.147	0.124	0.543	1.132	0.005	0.024	0.022	527.856	0.021	0.004
Other Material Handling	2034	600	750	0.090	0.076	0.267	0.978	0.005	0.010	0.009	527.804	0.021	0.004
Other Material Handling	2034	750	999	0.092	0.077	2.330	0.980	0.005	0.020	0.018	527.804	0.021	0.004
Other Material Handling	2035	0	25	0.875	0.735	4.150	6.218	0.005	0.202	0.185	586.785	0.024	0.005
Other Material Handling	2035	25	50	0.424	0.357	3.313	4.378	0.005	0.052	0.047	588.751	0.024	0.005
Other Material Handling	2035	50	75	0.513	0.431	2.891	4.119	0.005	0.184	0.170	527.842	0.021	0.004
Other Material Handling	2035	75	100	0.186	0.157	1.569	3.500	0.005	0.027	0.025	528.611	0.021	0.004
Other Material Handling	2035	100	175	0.172	0.144	0.752	3.244	0.005	0.030	0.028	527.812	0.021	0.004
Other Material Handling	2035	175	300	0.180	0.151	0.638	1.139	0.005	0.023	0.021	528.016	0.021	0.004
Other Material Handling	2035	300	600	0.144	0.121	0.508	1.132	0.005	0.021	0.019	527.856	0.021	0.004
Other Material Handling	2035	600	750	0.090	0.076	0.267	0.978	0.005	0.010	0.009	527.804	0.021	0.004
Other Material Handling	2035	750	999	0.092	0.077	2.330	0.980	0.005	0.020	0.018	527.804	0.021	0.004
Pavers	2025	0	25	1.038	0.858	6.558	3.542	0.011	0.245	0.226	860.205	0.035	0.007
Pavers	2025	25	50	1.089	0.915	4.118	4.929	0.005	0.264	0.243	587.425	0.024	0.005
Pavers	2025	50	75	0.720	0.605	4.905	3.706	0.005	0.420	0.386	524.498	0.021	0.004
Pavers	2025	75	100	0.295	0.248	2.646	3.445	0.005	0.139	0.128	526.537	0.021	0.004
Pavers	2025	100	175	0.220	0.185	1.676	3.014	0.005	0.080	0.073	528.494	0.021	0.004
Pavers	2025	175	300	0.130	0.110	1.069	1.000	0.005	0.036	0.033	528.337	0.021	0.004
Pavers	2025	300	600	0.128	0.108	1.041	0.980	0.005	0.032	0.029	527.676	0.021	0.004
Pavers	2025	600	750	0.075	0.063	0.263	0.954	0.005	0.009	0.008	527.836	0.021	0.004
Pavers	2026	0	25	1.038	0.858	6.558	3.542	0.011	0.245	0.225	860.219	0.035	0.007
Pavers	2026	25	50	1.047	0.880	4.047	4.903	0.005	0.249	0.229	588.023	0.024	0.005
Pavers	2026	50	75	0.645	0.542	4.534	3.673	0.005	0.368	0.338	525.253	0.021	0.004
Pavers	2026	75	100	0.282	0.237	2.533	3.431	0.005	0.129	0.119	525.804	0.021	0.004
Pavers	2026	100	175	0.206	0.173	1.497	3.012	0.005	0.073	0.067	528.486	0.021	0.004
Pavers	2026	175	300	0.129	0.108	1.000	1.002	0.005	0.034	0.031	528.275	0.021	0.004
Pavers	2026	300	600	0.123	0.104	0.891	0.980	0.005	0.031	0.028	527.269	0.021	0.004
Pavers	2026	600	750	0.080	0.067	0.264	0.962	0.005	0.009	0.009	528.473	0.021	0.004
Pavers	2027	0	25	1.035	0.855	6.539	3.532	0.011	0.244	0.225	857.700	0.035	0.007
Pavers	2027	25	50	1.005	0.845	3.980	4.866	0.005	0.234	0.215	588.960	0.024	0.005
Pavers	2027	50	75	0.502	0.422	3.736	3.560	0.005	0.273	0.251	526.951	0.021	0.004
Pavers	2027	75	100	0.273	0.229	2.450	3.438	0.005	0.119	0.110	525.809	0.021	0.004
Pavers	2027	100	175	0.199	0.167	1.382	3.020	0.005	0.068	0.062	528.501	0.021	0.004
Pavers	2027	175	300	0.129	0.108	0.942	1.009	0.005	0.032	0.029	528.745	0.021	0.004
Pavers	2027	300	600	0.116	0.097	0.767	0.980	0.005	0.025	0.023	527.382	0.021	0.004
Pavers	2027	600	750	0.084	0.071	0.265	0.968	0.005	0.009	0.009	527.836	0.021	0.004
Pavers	2028	0	25	1.036	0.856	6.547	3.536	0.011	0.245	0.225	858.741	0.035	0.007
Pavers	2028	25	50	0.965	0.811	3.932	4.841	0.005	0.221	0.203	588.686	0.024	0.005
Pavers	2028	50	75	0.484	0.407	3.585	3.561	0.005	0.258	0.238	526.960	0.021	0.004
Pavers	2028	75	100	0.257	0.216	2.338	3.435	0.005	0.105	0.097	525.896	0.021	0.004
Pavers	2028	100	175	0.185	0.156	1.225	3.016	0.005	0.059	0.054	528.484	0.021	0.004
Pavers	2028	175	300	0.125	0.105	0.845	1.011	0.005	0.029	0.026	528.843	0.021	0.004
Pavers	2028	300	600	0.120	0.101	0.771	0.985	0.005	0.026	0.023	526.924	0.021	0.004
Pavers	2028	600	750	0.089	0.075	0.267	0.975	0.005	0.009	0.009	527.836	0.021	0.004
Pavers	2029	0	25	1.035	0.856	6.543	3.534	0.011	0.244	0.225	858.280	0.035	0.007
Pavers	2029	25	50	0.955	0.802	3.922	4.873	0.005	0.217	0.199	589.263	0.024	0.005
Pavers	2029	50	75	0.491	0.413	3.614	3.588	0.005	0.259	0.239	526.670	0.021	0.004
Pavers	2029	75	100	0.249	0.210	2.244	3.431	0.005	0.098	0.091	525.843	0.021	0.004
Pavers	2029	100	175	0.183	0.154	1.178	3.021	0.005	0.058	0.053	528.331	0.021	0.004
Pavers	2029	175	300	0.119	0.100	0.710	1.011	0.005	0.025	0.023	528.571	0.021	0.004
Pavers	2029	300	600	0.118	0.099	0.755	0.979	0.005	0.025	0.023	524.973	0.021	0.004
Pavers	2029	750	999	0.094	0.079	0.268	0.983	0.005	0.010	0.009	528.473	0.021	0.004
Pavers	2030	0	25	1.035	0.855	6.538	3.531	0.011	0.244	0.225	857.667	0.035	0.007
Pavers	2030	25	50	0.928	0.780	3.872	4.835	0.005	0.201	0.185	589.263	0.024	0.005
Pavers	2030	50	75	0.463	0.389	3.487	3.574	0.005	0.246	0.226	526.670	0.021	0.004
Pavers	2030	75	100	0.233	0.196	2.134	3.424	0.005	0.087	0.080	525.843	0.021	0.004
Pavers	2030	100	175	0.176	0.148	1.099	3.019	0.005	0.055	0.050	528.331	0.021	0.004

Unmitigated EFs from Caleemod 2022 (based on OFFROAD 2017) Appx G, Table G-11

Equipment	Year	Low HP	High HP	TOG	ROG	NOX	CO	SO2	PM10	PM2.5	CO2	CH4	N2O
Pavers	2030	175	300	0.118	0.099	0.650	1.011	0.005	0.024	0.022	528.571	0.021	0.004
Pavers	2030	300	600	0.117	0.098	0.625	0.979	0.005	0.024	0.022	524.973	0.021	0.004
Pavers	2030	600	750	0.094	0.079	0.268	0.983	0.005	0.010	0.009	528.473	0.021	0.004
Pavers	2031	0	25	1.036	0.856	6.545	3.535	0.011	0.245	0.225	858.513	0.035	0.007
Pavers	2031	25	50	0.902	0.758	3.865	4.810	0.005	0.193	0.177	589.263	0.024	0.005
Pavers	2031	50	75	0.438	0.368	3.380	3.542	0.005	0.235	0.216	526.670	0.021	0.004
Pavers	2031	75	100	0.231	0.194	2.087	3.426	0.005	0.083	0.076	525.846	0.021	0.004
Pavers	2031	100	175	0.168	0.141	0.986	3.007	0.005	0.049	0.045	528.332	0.021	0.004
Pavers	2031	175	300	0.116	0.098	0.604	1.011	0.005	0.023	0.021	528.571	0.021	0.004
Pavers	2031	300	600	0.116	0.097	0.611	0.979	0.005	0.024	0.022	524.973	0.021	0.004
Pavers	2031	600	750	0.094	0.079	0.268	0.983	0.005	0.010	0.009	528.473	0.021	0.004
Pavers	2032	0	25	1.034	0.855	6.537	3.531	0.011	0.244	0.225	857.438	0.035	0.007
Pavers	2032	25	50	0.841	0.706	3.830	4.745	0.005	0.182	0.167	589.263	0.024	0.005
Pavers	2032	50	75	0.412	0.346	3.274	3.529	0.005	0.220	0.203	526.670	0.021	0.004
Pavers	2032	75	100	0.226	0.190	2.018	3.424	0.005	0.079	0.072	525.846	0.021	0.004
Pavers	2032	100	175	0.165	0.139	0.937	3.004	0.005	0.048	0.044	528.332	0.021	0.004
Pavers	2032	175	300	0.114	0.096	0.569	1.011	0.005	0.020	0.018	528.571	0.021	0.004
Pavers	2032	300	600	0.116	0.097	0.604	0.979	0.005	0.024	0.022	524.973	0.021	0.004
Pavers	2032	600	750	0.094	0.079	0.268	0.983	0.005	0.010	0.009	528.473	0.021	0.004
Pavers	2033	0	25	1.034	0.854	6.532	3.528	0.011	0.244	0.225	856.857	0.035	0.007
Pavers	2033	25	50	0.774	0.651	3.801	4.668	0.005	0.172	0.158	589.263	0.024	0.005
Pavers	2033	50	75	0.388	0.326	2.949	3.518	0.005	0.204	0.187	526.670	0.021	0.004
Pavers	2033	75	100	0.215	0.181	1.963	3.416	0.005	0.069	0.064	525.846	0.021	0.004
Pavers	2033	100	175	0.158	0.132	0.868	3.004	0.005	0.045	0.041	528.332	0.021	0.004
Pavers	2033	175	300	0.111	0.094	0.530	1.011	0.005	0.017	0.016	528.571	0.021	0.004
Pavers	2033	300	600	0.116	0.097	0.604	0.979	0.005	0.024	0.022	524.973	0.021	0.004
Pavers	2033	600	750	0.094	0.079	0.268	0.983	0.005	0.010	0.009	528.473	0.021	0.004
Pavers	2034	0	25	1.033	0.854	6.528	3.526	0.011	0.244	0.224	856.292	0.035	0.007
Pavers	2034	25	50	0.711	0.598	3.761	4.607	0.005	0.162	0.149	589.263	0.024	0.005
Pavers	2034	50	75	0.303	0.254	2.664	3.466	0.005	0.150	0.138	526.630	0.021	0.004
Pavers	2034	75	100	0.217	0.182	1.930	3.420	0.005	0.068	0.062	525.859	0.021	0.004
Pavers	2034	100	175	0.151	0.127	0.807	3.004	0.005	0.041	0.038	528.332	0.021	0.004
Pavers	2034	175	300	0.109	0.091	0.481	1.011	0.005	0.014	0.013	528.571	0.021	0.004
Pavers	2034	300	600	0.112	0.094	0.548	0.979	0.005	0.019	0.017	524.973	0.021	0.004
Pavers	2034	600	750	0.094	0.079	0.268	0.983	0.005	0.010	0.009	528.473	0.021	0.004
Pavers	2035	0	25	1.035	0.855	6.538	3.531	0.011	0.244	0.225	857.569	0.035	0.007
Pavers	2035	25	50	0.666	0.560	3.659	4.563	0.005	0.145	0.133	589.263	0.024	0.005
Pavers	2035	50	75	0.322	0.270	2.771	3.486	0.005	0.164	0.151	526.670	0.021	0.004
Pavers	2035	75	100	0.199	0.167	1.857	3.410	0.005	0.053	0.049	525.846	0.021	0.004
Pavers	2035	100	175	0.146	0.123	0.776	3.004	0.005	0.038	0.035	528.332	0.021	0.004
Pavers	2035	175	300	0.104	0.087	0.420	1.005	0.005	0.012	0.011	528.571	0.021	0.004
Pavers	2035	300	600	0.107	0.090	0.440	0.979	0.005	0.013	0.012	524.973	0.021	0.004
Pavers	2035	600	750	0.094	0.079	0.268	0.983	0.005	0.010	0.009	528.473	0.021	0.004
Paving Equipment	2025	0	25	1.026	0.848	6.483	3.502	0.011	0.242	0.223	850.426	0.034	0.007
Paving Equipment	2025	25	50	0.570	0.479	3.646	4.225	0.005	0.142	0.131	585.796	0.024	0.005
Paving Equipment	2025	50	75	1.058	0.889	6.658	4.184	0.005	0.662	0.609	523.953	0.021	0.004
Paving Equipment	2025	75	100	0.241	0.202	2.216	3.418	0.005	0.089	0.082	527.686	0.021	0.004
Paving Equipment	2025	100	175	0.235	0.197	1.696	3.088	0.005	0.089	0.082	526.935	0.021	0.004
Paving Equipment	2025	175	300	0.183	0.154	1.397	1.102	0.005	0.056	0.051	528.599	0.021	0.004
Paving Equipment	2025	300	600	0.119	0.100	0.699	1.002	0.005	0.022	0.020	527.009	0.021	0.004
Paving Equipment	2025	600	750	0.116	0.098	0.698	0.972	0.005	0.011	0.010	528.037	0.021	0.004
Paving Equipment	2025	750	999	0.139	0.117	2.377	1.010	0.005	0.040	0.037	528.095	0.021	0.004
Paving Equipment	2026	0	25	1.061	0.878	6.473	3.571	0.011	0.251	0.231	845.672	0.034	0.007
Paving Equipment	2026	25	50	0.525	0.441	3.587	4.175	0.005	0.128	0.117	585.967	0.024	0.005
Paving Equipment	2026	50	75	0.952	0.800	6.458	4.143	0.005	0.603	0.555	526.691	0.021	0.004
Paving Equipment	2026	75	100	0.226	0.190	2.065	3.403	0.005	0.080	0.074	527.706	0.021	0.004
Paving Equipment	2026	100	175	0.214	0.180	1.528	3.080	0.005	0.075	0.069	527.529	0.021	0.004
Paving Equipment	2026	175	300	0.185	0.155	1.341	1.108	0.005	0.055	0.050	528.621	0.021	0.004
Paving Equipment	2026	300	600	0.114	0.096	0.573	1.002	0.005	0.022	0.020	526.904	0.021	0.004
Paving Equipment	2026	600	750	0.123	0.104	0.712	0.978	0.005	0.011	0.010	526.629	0.021	0.004
Paving Equipment	2026	750	999	0.146	0.122	2.389	1.017	0.005	0.041	0.038	528.095	0.021	0.004
Paving Equipment	2027	0	25	1.063	0.879	6.479	3.576	0.011	0.252	0.231	846.356	0.034	0.007
Paving Equipment	2027	25	50	0.526	0.442	3.587	4.163	0.005	0.129	0.119	586.020	0.024	0.005
Paving Equipment	2027	50	75	1.169	0.982	7.603	4.337	0.005	0.737	0.678	530.236	0.022	0.004
Paving Equipment	2027	75	100	0.218	0.183	2.016	3.403	0.005	0.075	0.069	528.068	0.021	0.004
Paving Equipment	2027	100	175	0.204	0.172	1.417	3.071	0.005	0.068	0.063	527.656	0.021	0.004

Unmitigated EFs from Caleemod 2022 (based on OFFROAD 2017) Appx G, Table G-11

Equipment	Year	Low HP	High HP	TOG	ROG	NOX	CO	SO2	PM10	PM2.5	CO2	CH4	N2O
Paving Equipment	2027	175	300	0.175	0.147	1.164	1.115	0.005	0.048	0.044	529.152	0.021	0.004
Paving Equipment	2027	300	600	0.111	0.093	0.510	1.003	0.005	0.019	0.018	526.815	0.021	0.004
Paving Equipment	2027	600	750	0.130	0.109	0.714	0.985	0.005	0.011	0.010	526.534	0.021	0.004
Paving Equipment	2027	750	999	0.152	0.127	2.401	1.024	0.005	0.042	0.038	528.095	0.021	0.004
Paving Equipment	2028	0	25	1.064	0.880	6.480	3.578	0.011	0.252	0.232	846.475	0.034	0.007
Paving Equipment	2028	25	50	0.517	0.435	3.584	4.189	0.005	0.126	0.116	586.634	0.024	0.005
Paving Equipment	2028	50	75	1.313	1.103	8.023	4.438	0.005	0.823	0.757	527.592	0.021	0.004
Paving Equipment	2028	75	100	0.194	0.163	1.883	3.377	0.005	0.058	0.053	527.910	0.021	0.004
Paving Equipment	2028	100	175	0.207	0.174	1.330	3.069	0.005	0.071	0.066	527.542	0.021	0.004
Paving Equipment	2028	175	300	0.181	0.152	1.168	1.125	0.005	0.048	0.044	529.150	0.021	0.004
Paving Equipment	2028	300	600	0.116	0.097	0.512	1.010	0.005	0.019	0.018	526.638	0.021	0.004
Paving Equipment	2028	600	750	0.135	0.114	0.716	0.993	0.005	0.011	0.010	526.425	0.021	0.004
Paving Equipment	2028	750	999	0.158	0.132	2.412	1.032	0.005	0.042	0.039	528.095	0.021	0.004
Paving Equipment	2029	0	25	1.065	0.881	6.484	3.582	0.011	0.252	0.232	846.953	0.034	0.007
Paving Equipment	2029	25	50	0.522	0.439	3.566	4.224	0.005	0.123	0.113	586.573	0.024	0.005
Paving Equipment	2029	50	75	0.651	0.547	4.611	3.845	0.005	0.398	0.366	529.844	0.021	0.004
Paving Equipment	2029	75	100	0.195	0.164	1.845	3.384	0.005	0.054	0.049	527.611	0.021	0.004
Paving Equipment	2029	100	175	0.202	0.170	1.251	3.073	0.005	0.067	0.062	527.708	0.021	0.004
Paving Equipment	2029	175	300	0.187	0.157	1.197	1.127	0.005	0.050	0.046	528.738	0.021	0.004
Paving Equipment	2029	300	600	0.109	0.091	0.411	1.012	0.005	0.014	0.013	527.844	0.021	0.004
Paving Equipment	2029	600	750	0.141	0.119	0.718	1.001	0.005	0.011	0.011	526.539	0.021	0.004
Paving Equipment	2029	750	999	0.163	0.137	2.423	1.039	0.005	0.043	0.039	528.095	0.021	0.004
Paving Equipment	2030	0	25	1.065	0.881	6.485	3.582	0.011	0.252	0.232	847.062	0.034	0.007
Paving Equipment	2030	25	50	0.476	0.400	3.480	4.174	0.005	0.103	0.095	586.573	0.024	0.005
Paving Equipment	2030	50	75	0.593	0.499	4.356	3.817	0.005	0.365	0.336	529.844	0.021	0.004
Paving Equipment	2030	75	100	0.193	0.162	1.813	3.384	0.005	0.052	0.048	527.611	0.021	0.004
Paving Equipment	2030	100	175	0.200	0.168	1.223	3.073	0.005	0.067	0.061	527.708	0.021	0.004
Paving Equipment	2030	175	300	0.183	0.153	1.136	1.127	0.005	0.045	0.041	528.738	0.021	0.004
Paving Equipment	2030	300	600	0.108	0.090	0.396	1.012	0.005	0.014	0.013	527.844	0.021	0.004
Paving Equipment	2030	600	750	0.141	0.119	0.718	1.001	0.005	0.011	0.011	526.539	0.021	0.004
Paving Equipment	2030	750	999	0.163	0.137	2.423	1.039	0.005	0.043	0.039	528.095	0.021	0.004
Paving Equipment	2031	0	25	1.065	0.881	6.482	3.581	0.011	0.252	0.232	846.640	0.034	0.007
Paving Equipment	2031	25	50	0.411	0.345	3.435	4.110	0.005	0.089	0.082	586.573	0.024	0.005
Paving Equipment	2031	50	75	0.572	0.481	4.220	3.810	0.005	0.318	0.293	529.844	0.021	0.004
Paving Equipment	2031	75	100	0.190	0.159	1.734	3.383	0.005	0.050	0.046	527.611	0.021	0.004
Paving Equipment	2031	100	175	0.186	0.157	1.053	3.069	0.005	0.060	0.055	527.706	0.021	0.004
Paving Equipment	2031	175	300	0.185	0.156	1.121	1.136	0.005	0.047	0.043	528.731	0.021	0.004
Paving Equipment	2031	300	600	0.106	0.089	0.366	1.012	0.005	0.014	0.013	527.844	0.021	0.004
Paving Equipment	2031	600	750	0.141	0.119	0.718	1.001	0.005	0.011	0.011	526.539	0.021	0.004
Paving Equipment	2031	750	999	0.131	0.110	2.423	1.039	0.005	0.023	0.021	528.095	0.021	0.004
Paving Equipment	2032	0	25	1.065	0.881	6.483	3.581	0.011	0.252	0.232	846.838	0.034	0.007
Paving Equipment	2032	25	50	0.384	0.322	3.429	4.084	0.005	0.083	0.076	586.573	0.024	0.005
Paving Equipment	2032	50	75	0.484	0.407	3.822	3.767	0.005	0.261	0.240	529.844	0.021	0.004
Paving Equipment	2032	75	100	0.187	0.157	1.708	3.378	0.005	0.049	0.045	527.611	0.021	0.004
Paving Equipment	2032	100	175	0.184	0.155	1.012	3.066	0.005	0.059	0.054	527.708	0.021	0.004
Paving Equipment	2032	175	300	0.168	0.141	0.926	1.111	0.005	0.035	0.032	528.738	0.021	0.004
Paving Equipment	2032	300	600	0.106	0.089	0.366	1.012	0.005	0.014	0.013	527.844	0.021	0.004
Paving Equipment	2032	600	750	0.123	0.104	0.494	1.001	0.005	0.008	0.007	526.539	0.021	0.004
Paving Equipment	2032	750	999	0.131	0.110	2.423	1.039	0.005	0.023	0.021	528.095	0.021	0.004
Paving Equipment	2033	0	25	1.038	0.858	6.476	3.555	0.011	0.248	0.228	846.857	0.034	0.007
Paving Equipment	2033	25	50	0.366	0.307	3.395	4.066	0.005	0.072	0.066	586.573	0.024	0.005
Paving Equipment	2033	50	75	0.417	0.350	3.649	3.735	0.005	0.199	0.183	529.844	0.021	0.004
Paving Equipment	2033	75	100	0.187	0.157	1.699	3.378	0.005	0.048	0.044	527.611	0.021	0.004
Paving Equipment	2033	100	175	0.180	0.151	0.984	3.062	0.005	0.056	0.052	527.708	0.021	0.004
Paving Equipment	2033	175	300	0.158	0.133	0.798	1.111	0.005	0.027	0.025	528.738	0.021	0.004
Paving Equipment	2033	300	600	0.106	0.089	0.366	1.012	0.005	0.014	0.013	527.844	0.021	0.004
Paving Equipment	2033	600	750	0.123	0.104	0.494	1.001	0.005	0.008	0.007	526.539	0.021	0.004
Paving Equipment	2033	750	999	0.131	0.110	2.423	1.039	0.005	0.023	0.021	528.095	0.021	0.004
Paving Equipment	2034	0	25	1.028	0.850	6.472	3.545	0.011	0.247	0.227	846.536	0.034	0.007
Paving Equipment	2034	25	50	0.347	0.292	3.321	4.048	0.005	0.061	0.056	586.573	0.024	0.005
Paving Equipment	2034	50	75	0.363	0.305	3.095	3.718	0.005	0.169	0.155	529.844	0.021	0.004
Paving Equipment	2034	75	100	0.187	0.157	1.699	3.378	0.005	0.048	0.044	527.611	0.021	0.004
Paving Equipment	2034	100	175	0.174	0.146	0.938	3.061	0.005	0.052	0.048	527.708	0.021	0.004
Paving Equipment	2034	175	300	0.155	0.130	0.770	1.095	0.005	0.026	0.024	528.738	0.021	0.004
Paving Equipment	2034	300	600	0.106	0.089	0.366	1.012	0.005	0.014	0.013	527.844	0.021	0.004
Paving Equipment	2034	600	750	0.123	0.104	0.494	1.001	0.005	0.008	0.007	526.539	0.021	0.004

Unmitigated EFs from Caleemod 2022 (based on OFFROAD 2017) Appx G, Table G-11

Equipment	Year	Low HP	High HP	TOG	ROG	NOX	CO	SO2	PM10	PM2.5	CO2	CH4	N2O
Paving Equipment	2034	750	999	0.131	0.110	2.423	1.039	0.005	0.023	0.021	528.095	0.021	0.004
Paving Equipment	2035	0	25	1.025	0.847	6.475	3.542	0.011	0.247	0.227	847.065	0.034	0.007
Paving Equipment	2035	25	50	0.323	0.271	3.251	4.025	0.005	0.045	0.041	586.573	0.024	0.005
Paving Equipment	2035	50	75	0.356	0.299	3.076	3.714	0.005	0.165	0.152	529.844	0.021	0.004
Paving Equipment	2035	75	100	0.183	0.153	1.676	3.376	0.005	0.042	0.039	527.611	0.021	0.004
Paving Equipment	2035	100	175	0.168	0.142	0.890	3.054	0.005	0.050	0.046	527.708	0.021	0.004
Paving Equipment	2035	175	300	0.149	0.125	0.669	1.095	0.005	0.024	0.022	528.738	0.021	0.004
Paving Equipment	2035	300	600	0.100	0.084	0.344	0.987	0.005	0.012	0.011	527.844	0.021	0.004
Paving Equipment	2035	600	750	0.107	0.090	0.271	1.001	0.005	0.008	0.007	526.539	0.021	0.004
Paving Equipment	2035	750	999	0.131	0.110	2.423	1.039	0.005	0.023	0.021	528.095	0.021	0.004
Plate Compactors	2025	0	25	0.662	0.547	4.144	3.471	0.009	0.162	0.149	568.406	0.023	0.005
Plate Compactors	2026	0	25	0.662	0.547	4.143	3.470	0.009	0.162	0.149	568.337	0.023	0.005
Plate Compactors	2027	0	25	0.662	0.547	4.143	3.470	0.009	0.162	0.149	568.318	0.023	0.005
Plate Compactors	2028	0	25	0.662	0.547	4.143	3.471	0.009	0.162	0.149	568.389	0.023	0.005
Plate Compactors	2029	0	25	0.662	0.547	4.143	3.470	0.009	0.162	0.149	568.343	0.023	0.005
Plate Compactors	2030	0	25	0.662	0.547	4.143	3.470	0.009	0.162	0.149	568.372	0.023	0.005
Plate Compactors	2031	0	25	0.662	0.547	4.143	3.470	0.009	0.162	0.149	568.294	0.023	0.005
Plate Compactors	2032	0	25	0.662	0.547	4.143	3.470	0.009	0.162	0.149	568.291	0.023	0.005
Plate Compactors	2033	0	25	0.662	0.547	4.143	3.470	0.009	0.162	0.149	568.358	0.023	0.005
Plate Compactors	2034	0	25	0.662	0.547	4.143	3.470	0.009	0.162	0.149	568.347	0.023	0.005
Plate Compactors	2035	0	25	0.662	0.547	4.143	3.470	0.009	0.162	0.149	568.362	0.023	0.005
Pressure Washers	2025	0	25	0.640	0.529	4.377	3.262	0.009	0.181	0.166	577.829	0.023	0.005
Pressure Washers	2025	25	50	0.315	0.260	3.429	3.291	0.008	0.077	0.071	582.656	0.024	0.005
Pressure Washers	2026	0	25	0.636	0.526	4.349	3.253	0.009	0.178	0.163	577.730	0.023	0.005
Pressure Washers	2026	25	50	0.290	0.240	3.333	3.271	0.008	0.065	0.060	583.021	0.024	0.005
Pressure Washers	2027	0	25	0.634	0.524	4.331	3.250	0.009	0.175	0.161	578.370	0.023	0.005
Pressure Washers	2027	25	50	0.268	0.222	3.241	3.252	0.008	0.054	0.050	583.375	0.024	0.005
Pressure Washers	2028	0	25	0.630	0.521	4.309	3.243	0.009	0.173	0.159	578.034	0.023	0.005
Pressure Washers	2028	25	50	0.248	0.205	3.144	3.222	0.008	0.044	0.040	581.131	0.024	0.005
Pressure Washers	2029	0	25	0.629	0.520	4.296	3.242	0.009	0.171	0.157	578.387	0.023	0.005
Pressure Washers	2029	25	50	0.233	0.193	3.094	3.209	0.008	0.037	0.034	581.535	0.024	0.005
Pressure Washers	2030	0	25	0.627	0.518	4.283	3.238	0.009	0.169	0.156	578.062	0.023	0.005
Pressure Washers	2030	25	50	0.220	0.182	3.056	3.194	0.008	0.031	0.029	580.913	0.024	0.005
Pressure Washers	2031	0	25	0.626	0.518	4.278	3.239	0.009	0.168	0.155	578.392	0.023	0.005
Pressure Washers	2031	25	50	0.210	0.174	3.025	3.183	0.008	0.027	0.025	580.561	0.024	0.005
Pressure Washers	2032	0	25	0.625	0.517	4.270	3.237	0.009	0.167	0.154	577.961	0.023	0.005
Pressure Washers	2032	25	50	0.203	0.168	2.995	3.172	0.007	0.023	0.021	579.608	0.024	0.005
Pressure Washers	2033	0	25	0.625	0.516	4.265	3.236	0.009	0.166	0.153	577.764	0.023	0.005
Pressure Washers	2033	25	50	0.198	0.163	2.978	3.173	0.008	0.020	0.018	580.611	0.024	0.005
Pressure Washers	2034	0	25	0.624	0.516	4.262	3.236	0.009	0.166	0.152	577.713	0.023	0.005
Pressure Washers	2034	25	50	0.194	0.160	2.960	3.169	0.008	0.018	0.016	580.477	0.024	0.005
Pressure Washers	2035	0	25	0.624	0.515	4.259	3.234	0.009	0.165	0.152	577.434	0.023	0.005
Pressure Washers	2035	25	50	0.192	0.159	2.949	3.174	0.008	0.016	0.014	581.538	0.024	0.005
Pumps	2025	0	25	0.695	0.574	4.334	3.001	0.008	0.181	0.166	568.244	0.023	0.005
Pumps	2025	25	50	0.486	0.401	3.528	3.943	0.007	0.099	0.091	568.336	0.023	0.005
Pumps	2026	0	25	0.688	0.569	4.309	2.993	0.008	0.177	0.163	568.310	0.023	0.005
Pumps	2026	25	50	0.451	0.373	3.428	3.914	0.007	0.084	0.078	568.369	0.023	0.005
Pumps	2027	0	25	0.683	0.565	4.288	2.986	0.008	0.173	0.160	568.297	0.023	0.005
Pumps	2027	25	50	0.419	0.346	3.329	3.883	0.007	0.070	0.064	568.375	0.023	0.005
Pumps	2028	0	25	0.679	0.561	4.270	2.980	0.008	0.171	0.157	568.344	0.023	0.005
Pumps	2028	25	50	0.391	0.323	3.239	3.856	0.007	0.057	0.052	568.334	0.023	0.005
Pumps	2029	0	25	0.676	0.559	4.255	2.976	0.008	0.168	0.155	568.320	0.023	0.005
Pumps	2029	25	50	0.368	0.304	3.184	3.833	0.007	0.048	0.044	568.334	0.023	0.005
Pumps	2030	0	25	0.674	0.557	4.245	2.974	0.008	0.166	0.153	568.352	0.023	0.005
Pumps	2030	25	50	0.349	0.288	3.147	3.814	0.007	0.041	0.038	568.301	0.023	0.005
Pumps	2031	0	25	0.673	0.556	4.238	2.974	0.008	0.165	0.152	568.325	0.023	0.005
Pumps	2031	25	50	0.334	0.276	3.116	3.800	0.007	0.035	0.032	568.345	0.023	0.005
Pumps	2032	0	25	0.673	0.556	4.234	2.974	0.008	0.164	0.151	568.328	0.023	0.005
Pumps	2032	25	50	0.323	0.267	3.089	3.790	0.007	0.030	0.028	568.302	0.023	0.005
Pumps	2033	0	25	0.672	0.556	4.230	2.973	0.008	0.163	0.150	568.301	0.023	0.005
Pumps	2033	25	50	0.315	0.260	3.065	3.784	0.007	0.026	0.024	568.323	0.023	0.005
Pumps	2034	0	25	0.672	0.556	4.228	2.974	0.008	0.163	0.150	568.339	0.023	0.005
Pumps	2034	25	50	0.310	0.256	3.046	3.780	0.007	0.023	0.021	568.311	0.023	0.005
Pumps	2035	0	25	0.672	0.556	4.227	2.974	0.008	0.162	0.149	568.332	0.023	0.005
Pumps	2035	25	50	0.307	0.254	3.029	3.778	0.007	0.020	0.018	568.349	0.023	0.005
Rollers	2025	0	25	1.008	0.833	6.317	4.394	0.012	0.242	0.223	847.999	0.034	0.007

Unmitigated EFs from Caleemod 2022 (based on OFFROAD 2017) Appx G, Table G-11

Equipment	Year	Low HP	High HP	TOG	ROG	NOX	CO	SO2	PM10	PM2.5	CO2	CH4	N2O
Rollers	2025	25	50	0.675	0.567	3.678	4.113	0.005	0.166	0.153	586.902	0.024	0.005
Rollers	2025	50	75	2.239	1.882	15.110	6.171	0.005	1.081	0.994	527.546	0.021	0.004
Rollers	2025	75	100	0.290	0.244	2.601	3.414	0.005	0.129	0.118	528.034	0.021	0.004
Rollers	2025	100	175	0.151	0.127	1.100	2.906	0.005	0.049	0.045	527.452	0.021	0.004
Rollers	2025	175	300	0.248	0.208	2.175	1.522	0.005	0.087	0.080	528.085	0.021	0.004
Rollers	2025	300	600	0.170	0.143	1.428	1.422	0.005	0.049	0.046	529.722	0.021	0.004
Rollers	2026	0	25	1.008	0.833	6.318	4.395	0.012	0.242	0.223	848.045	0.034	0.007
Rollers	2026	25	50	0.645	0.542	3.614	4.093	0.005	0.154	0.142	586.914	0.024	0.005
Rollers	2026	50	75	2.254	1.894	15.168	6.197	0.005	1.090	1.002	527.546	0.021	0.004
Rollers	2026	75	100	0.274	0.231	2.484	3.411	0.005	0.116	0.106	528.012	0.021	0.004
Rollers	2026	100	175	0.144	0.121	1.000	2.911	0.005	0.044	0.041	527.368	0.021	0.004
Rollers	2026	175	300	0.243	0.204	2.057	1.519	0.005	0.083	0.077	528.142	0.021	0.004
Rollers	2026	300	600	0.175	0.147	1.452	1.437	0.005	0.051	0.046	528.943	0.021	0.004
Rollers	2027	0	25	1.008	0.833	6.318	4.395	0.012	0.242	0.223	848.116	0.034	0.007
Rollers	2027	25	50	0.629	0.529	3.577	4.105	0.005	0.146	0.134	587.122	0.024	0.005
Rollers	2027	50	75	2.268	1.905	15.225	6.223	0.005	1.099	1.011	527.546	0.021	0.004
Rollers	2027	75	100	0.263	0.221	2.384	3.411	0.005	0.105	0.097	528.181	0.021	0.004
Rollers	2027	100	175	0.134	0.112	0.876	2.918	0.005	0.038	0.035	527.397	0.021	0.004
Rollers	2027	175	300	0.224	0.188	1.757	1.479	0.005	0.074	0.068	528.054	0.021	0.004
Rollers	2027	300	600	0.180	0.151	1.503	1.460	0.005	0.053	0.048	528.733	0.021	0.004
Rollers	2028	0	25	1.008	0.833	6.318	4.395	0.012	0.242	0.223	848.056	0.034	0.007
Rollers	2028	25	50	0.596	0.501	3.509	4.084	0.005	0.132	0.121	587.117	0.024	0.005
Rollers	2028	50	75	2.279	1.915	15.271	6.244	0.005	1.106	1.017	527.546	0.021	0.004
Rollers	2028	75	100	0.248	0.209	2.269	3.408	0.005	0.094	0.087	528.379	0.021	0.004
Rollers	2028	100	175	0.129	0.108	0.794	2.925	0.005	0.035	0.032	527.409	0.021	0.004
Rollers	2028	175	300	0.218	0.183	1.673	1.475	0.005	0.071	0.065	528.192	0.021	0.004
Rollers	2028	300	600	0.171	0.144	1.294	1.475	0.005	0.047	0.044	530.685	0.022	0.004
Rollers	2029	0	25	1.008	0.833	6.318	4.395	0.012	0.242	0.223	848.088	0.034	0.007
Rollers	2029	25	50	0.582	0.489	3.480	4.094	0.005	0.125	0.115	587.111	0.024	0.005
Rollers	2029	50	75	2.291	1.925	15.319	6.266	0.005	1.113	1.024	527.546	0.021	0.004
Rollers	2029	75	100	0.242	0.203	2.209	3.409	0.005	0.089	0.081	528.433	0.021	0.004
Rollers	2029	100	175	0.128	0.107	0.749	2.930	0.005	0.033	0.030	527.451	0.021	0.004
Rollers	2029	175	300	0.218	0.183	1.656	1.476	0.005	0.071	0.065	528.175	0.021	0.004
Rollers	2029	300	600	0.173	0.146	1.297	1.482	0.005	0.048	0.044	531.116	0.022	0.004
Rollers	2030	0	25	1.008	0.833	6.318	4.395	0.012	0.242	0.223	848.083	0.034	0.007
Rollers	2030	25	50	0.556	0.467	3.460	4.065	0.005	0.119	0.109	587.111	0.024	0.005
Rollers	2030	50	75	2.112	1.775	14.061	5.837	0.005	1.064	0.979	527.546	0.021	0.004
Rollers	2030	75	100	0.236	0.198	2.160	3.407	0.005	0.084	0.077	528.433	0.021	0.004
Rollers	2030	100	175	0.124	0.104	0.708	2.929	0.005	0.032	0.029	527.451	0.021	0.004
Rollers	2030	175	300	0.202	0.170	1.486	1.475	0.005	0.063	0.058	528.175	0.021	0.004
Rollers	2030	300	600	0.168	0.141	1.213	1.482	0.005	0.043	0.040	531.116	0.022	0.004
Rollers	2031	0	25	1.008	0.833	6.318	4.395	0.012	0.242	0.223	848.049	0.034	0.007
Rollers	2031	25	50	0.530	0.445	3.443	4.037	0.005	0.111	0.102	587.111	0.024	0.005
Rollers	2031	50	75	2.014	1.692	13.368	5.601	0.005	1.037	0.954	527.546	0.021	0.004
Rollers	2031	75	100	0.231	0.194	2.104	3.405	0.005	0.079	0.073	528.433	0.021	0.004
Rollers	2031	100	175	0.120	0.101	0.639	2.928	0.005	0.030	0.027	527.451	0.021	0.004
Rollers	2031	175	300	0.194	0.163	1.412	1.457	0.005	0.060	0.055	528.175	0.021	0.004
Rollers	2031	300	600	0.159	0.133	1.059	1.353	0.005	0.039	0.036	531.116	0.022	0.004
Rollers	2032	0	25	1.008	0.833	6.317	4.394	0.012	0.242	0.223	848.026	0.034	0.007
Rollers	2032	25	50	0.502	0.422	3.412	4.005	0.005	0.102	0.094	587.111	0.024	0.005
Rollers	2032	50	75	1.833	1.540	12.104	5.170	0.005	0.987	0.908	527.546	0.021	0.004
Rollers	2032	75	100	0.226	0.190	2.046	3.403	0.005	0.076	0.070	528.433	0.021	0.004
Rollers	2032	100	175	0.118	0.099	0.601	2.927	0.005	0.029	0.026	527.451	0.021	0.004
Rollers	2032	175	300	0.188	0.158	1.345	1.457	0.005	0.056	0.051	528.175	0.021	0.004
Rollers	2032	300	600	0.151	0.127	0.936	1.222	0.005	0.033	0.031	531.116	0.022	0.004
Rollers	2033	0	25	1.008	0.833	6.317	4.394	0.012	0.242	0.223	848.024	0.034	0.007
Rollers	2033	25	50	0.476	0.400	3.394	3.976	0.005	0.095	0.087	587.111	0.024	0.005
Rollers	2033	50	75	1.833	1.540	12.104	5.170	0.005	0.987	0.908	527.546	0.021	0.004
Rollers	2033	75	100	0.218	0.184	1.981	3.394	0.005	0.071	0.065	528.433	0.021	0.004
Rollers	2033	100	175	0.116	0.097	0.572	2.927	0.005	0.027	0.024	527.451	0.021	0.004
Rollers	2033	175	300	0.184	0.154	1.269	1.448	0.005	0.054	0.050	528.175	0.021	0.004
Rollers	2033	300	600	0.148	0.124	0.882	1.222	0.005	0.033	0.031	531.116	0.022	0.004
Rollers	2034	0	25	1.008	0.833	6.318	4.395	0.012	0.242	0.223	848.089	0.034	0.007
Rollers	2034	25	50	0.443	0.372	3.355	3.940	0.005	0.087	0.080	587.111	0.024	0.005
Rollers	2034	50	75	1.726	1.450	11.355	4.914	0.005	0.957	0.880	527.546	0.021	0.004
Rollers	2034	75	100	0.215	0.180	1.952	3.393	0.005	0.068	0.063	528.433	0.021	0.004

Unmitigated EFs from Caleemod 2022 (based on OFFROAD 2017) Appx G, Table G-11

Equipment	Year	Low HP	High HP	TOG	ROG	NOX	CO	SO2	PM10	PM2.5	CO2	CH4	N2O
Rollers	2034	100	175	0.112	0.094	0.547	2.927	0.005	0.024	0.022	527.451	0.021	0.004
Rollers	2034	175	300	0.182	0.153	1.209	1.448	0.005	0.052	0.048	528.175	0.021	0.004
Rollers	2034	300	600	0.142	0.120	0.759	1.222	0.005	0.031	0.028	531.116	0.022	0.004
Rollers	2035	0	25	1.008	0.833	6.317	4.394	0.012	0.242	0.223	848.038	0.034	0.007
Rollers	2035	25	50	0.424	0.356	3.325	3.921	0.005	0.080	0.074	587.111	0.024	0.005
Rollers	2035	50	75	1.660	1.395	10.897	4.757	0.005	0.938	0.863	527.546	0.021	0.004
Rollers	2035	75	100	0.208	0.175	1.923	3.390	0.005	0.063	0.058	528.433	0.021	0.004
Rollers	2035	100	175	0.110	0.092	0.525	2.927	0.005	0.023	0.021	527.451	0.021	0.004
Rollers	2035	175	300	0.180	0.152	1.195	1.447	0.005	0.052	0.048	528.175	0.021	0.004
Rollers	2035	300	600	0.140	0.118	0.725	1.222	0.005	0.031	0.028	531.116	0.022	0.004
Rough Terrain Forklifts	2025	0	25	0.495	0.416	5.040	4.163	0.005	0.288	0.265	587.236	0.024	0.005
Rough Terrain Forklifts	2025	25	50	0.543	0.456	3.460	3.735	0.005	0.126	0.116	587.160	0.024	0.005
Rough Terrain Forklifts	2025	50	75	1.748	1.469	12.074	5.063	0.005	0.884	0.813	529.994	0.021	0.004
Rough Terrain Forklifts	2025	75	100	0.141	0.118	1.694	3.221	0.005	0.036	0.033	528.726	0.021	0.004
Rough Terrain Forklifts	2025	100	175	0.213	0.179	1.471	2.942	0.005	0.101	0.093	527.759	0.021	0.004
Rough Terrain Forklifts	2025	175	300	0.140	0.117	1.406	0.995	0.005	0.034	0.031	528.299	0.021	0.004
Rough Terrain Forklifts	2025	300	600	0.088	0.074	0.527	0.957	0.005	0.009	0.008	527.807	0.021	0.004
Rough Terrain Forklifts	2025	600	750	0.142	0.119	1.348	0.985	0.005	0.010	0.009	527.403	0.021	0.004
Rough Terrain Forklifts	2026	0	25	0.440	0.370	5.014	4.089	0.005	0.261	0.240	586.999	0.024	0.005
Rough Terrain Forklifts	2026	25	50	0.496	0.417	3.356	3.688	0.005	0.107	0.099	587.450	0.024	0.005
Rough Terrain Forklifts	2026	50	75	1.758	1.477	12.115	5.083	0.005	0.891	0.820	530.057	0.022	0.004
Rough Terrain Forklifts	2026	75	100	0.137	0.115	1.643	3.220	0.005	0.033	0.030	528.889	0.021	0.004
Rough Terrain Forklifts	2026	100	175	0.199	0.167	1.307	2.932	0.005	0.092	0.085	527.710	0.021	0.004
Rough Terrain Forklifts	2026	175	300	0.138	0.116	1.345	0.995	0.005	0.031	0.029	527.851	0.021	0.004
Rough Terrain Forklifts	2026	300	600	0.091	0.077	0.528	0.962	0.005	0.009	0.009	528.219	0.021	0.004
Rough Terrain Forklifts	2026	600	750	0.145	0.122	1.351	0.989	0.005	0.010	0.009	527.403	0.021	0.004
Rough Terrain Forklifts	2027	0	25	0.450	0.378	5.032	4.144	0.005	0.264	0.242	586.999	0.024	0.005
Rough Terrain Forklifts	2027	25	50	0.447	0.376	3.287	3.642	0.005	0.091	0.084	587.756	0.024	0.005
Rough Terrain Forklifts	2027	50	75	1.769	1.486	12.157	5.103	0.005	0.899	0.827	530.131	0.022	0.004
Rough Terrain Forklifts	2027	75	100	0.134	0.113	1.619	3.216	0.005	0.032	0.029	528.688	0.021	0.004
Rough Terrain Forklifts	2027	100	175	0.185	0.155	1.123	2.919	0.005	0.081	0.075	527.860	0.021	0.004
Rough Terrain Forklifts	2027	175	300	0.107	0.090	0.934	0.972	0.005	0.019	0.018	528.408	0.021	0.004
Rough Terrain Forklifts	2027	300	600	0.094	0.079	0.529	0.966	0.005	0.009	0.009	528.234	0.021	0.004
Rough Terrain Forklifts	2027	600	750	0.149	0.125	1.355	0.992	0.005	0.010	0.009	527.403	0.021	0.004
Rough Terrain Forklifts	2028	0	25	0.460	0.387	5.049	4.198	0.005	0.266	0.245	586.999	0.024	0.005
Rough Terrain Forklifts	2028	25	50	0.402	0.338	3.209	3.588	0.005	0.076	0.070	587.488	0.024	0.005
Rough Terrain Forklifts	2028	50	75	0.473	0.397	5.776	3.676	0.005	0.324	0.298	530.811	0.022	0.004
Rough Terrain Forklifts	2028	75	100	0.130	0.109	1.576	3.208	0.005	0.029	0.027	528.604	0.021	0.004
Rough Terrain Forklifts	2028	100	175	0.177	0.148	1.056	2.918	0.005	0.077	0.071	527.687	0.021	0.004
Rough Terrain Forklifts	2028	175	300	0.105	0.088	0.817	0.973	0.005	0.017	0.015	527.537	0.021	0.004
Rough Terrain Forklifts	2028	300	600	0.097	0.082	0.533	0.970	0.005	0.009	0.009	527.806	0.021	0.004
Rough Terrain Forklifts	2028	600	750	0.152	0.128	1.358	0.996	0.005	0.010	0.009	527.403	0.021	0.004
Rough Terrain Forklifts	2029	0	25	0.470	0.395	5.067	4.252	0.005	0.269	0.248	586.999	0.024	0.005
Rough Terrain Forklifts	2029	25	50	0.393	0.330	3.163	3.550	0.005	0.072	0.066	587.380	0.024	0.005
Rough Terrain Forklifts	2029	50	75	0.483	0.406	5.820	3.702	0.005	0.329	0.303	531.785	0.022	0.004
Rough Terrain Forklifts	2029	75	100	0.125	0.105	1.559	3.198	0.005	0.027	0.025	528.728	0.021	0.004
Rough Terrain Forklifts	2029	100	175	0.174	0.146	1.126	2.984	0.005	0.069	0.064	527.903	0.021	0.004
Rough Terrain Forklifts	2029	175	300	0.106	0.089	0.820	0.975	0.005	0.017	0.016	527.909	0.021	0.004
Rough Terrain Forklifts	2029	300	600	0.101	0.085	0.537	0.974	0.005	0.009	0.009	528.104	0.021	0.004
Rough Terrain Forklifts	2029	600	750	0.156	0.131	1.361	0.999	0.005	0.010	0.009	527.403	0.021	0.004
Rough Terrain Forklifts	2030	0	25	0.392	0.329	4.538	4.172	0.005	0.214	0.197	586.999	0.024	0.005
Rough Terrain Forklifts	2030	25	50	0.390	0.327	3.162	3.547	0.005	0.071	0.065	587.380	0.024	0.005
Rough Terrain Forklifts	2030	50	75	0.483	0.406	5.820	3.702	0.005	0.329	0.303	531.785	0.022	0.004
Rough Terrain Forklifts	2030	75	100	0.124	0.104	1.541	3.198	0.005	0.026	0.024	528.728	0.021	0.004
Rough Terrain Forklifts	2030	100	175	0.170	0.143	1.087	2.980	0.005	0.067	0.062	527.903	0.021	0.004
Rough Terrain Forklifts	2030	175	300	0.103	0.087	0.753	0.975	0.005	0.017	0.016	527.909	0.021	0.004
Rough Terrain Forklifts	2030	300	600	0.101	0.085	0.537	0.974	0.005	0.009	0.009	528.104	0.021	0.004
Rough Terrain Forklifts	2030	600	750	0.156	0.131	1.361	0.999	0.005	0.010	0.009	527.403	0.021	0.004
Rough Terrain Forklifts	2031	0	25	0.392	0.329	4.538	4.172	0.005	0.214	0.197	586.999	0.024	0.005
Rough Terrain Forklifts	2031	25	50	0.384	0.322	3.160	3.541	0.005	0.067	0.061	587.380	0.024	0.005
Rough Terrain Forklifts	2031	50	75	0.387	0.325	3.813	3.660	0.005	0.264	0.243	531.785	0.022	0.004
Rough Terrain Forklifts	2031	75	100	0.122	0.102	1.517	3.195	0.005	0.025	0.023	528.728	0.021	0.004
Rough Terrain Forklifts	2031	100	175	0.163	0.137	1.051	2.980	0.005	0.063	0.058	527.903	0.021	0.004
Rough Terrain Forklifts	2031	175	300	0.096	0.081	0.597	0.975	0.005	0.017	0.016	527.909	0.021	0.004
Rough Terrain Forklifts	2031	300	600	0.096	0.080	0.428	0.974	0.005	0.009	0.009	528.104	0.021	0.004
Rough Terrain Forklifts	2031	600	750	0.156	0.131	1.361	0.999	0.005	0.010	0.009	527.403	0.021	0.004

Unmitigated EFs from Caleemod 2022 (based on OFFROAD 2017) Appx G, Table G-11

Equipment	Year	Low HP	High HP	TOG	ROG	NOX	CO	SO2	PM10	PM2.5	CO2	CH4	N2O
Rough Terrain Forklifts	2032	0	25	0.310	0.261	4.515	4.094	0.005	0.140	0.129	586.999	0.024	0.005
Rough Terrain Forklifts	2032	25	50	0.384	0.322	3.160	3.541	0.005	0.067	0.061	587.380	0.024	0.005
Rough Terrain Forklifts	2032	50	75	0.387	0.325	3.813	3.660	0.005	0.264	0.243	531.785	0.022	0.004
Rough Terrain Forklifts	2032	75	100	0.121	0.102	1.501	3.194	0.005	0.024	0.022	528.728	0.021	0.004
Rough Terrain Forklifts	2032	100	175	0.147	0.123	0.992	2.970	0.005	0.055	0.051	527.903	0.021	0.004
Rough Terrain Forklifts	2032	175	300	0.090	0.076	0.478	0.975	0.005	0.015	0.014	527.909	0.021	0.004
Rough Terrain Forklifts	2032	300	600	0.088	0.074	0.267	0.974	0.005	0.009	0.009	528.104	0.021	0.004
Rough Terrain Forklifts	2032	600	750	0.105	0.088	0.271	0.999	0.005	0.010	0.009	527.403	0.021	0.004
Rough Terrain Forklifts	2033	0	25	0.310	0.261	4.515	4.094	0.005	0.140	0.129	586.999	0.024	0.005
Rough Terrain Forklifts	2033	25	50	0.387	0.325	3.094	3.522	0.005	0.061	0.057	587.392	0.024	0.005
Rough Terrain Forklifts	2033	50	75	0.376	0.316	3.821	3.686	0.005	0.246	0.226	537.484	0.022	0.004
Rough Terrain Forklifts	2033	75	100	0.120	0.101	1.488	3.193	0.005	0.024	0.022	528.728	0.021	0.004
Rough Terrain Forklifts	2033	100	175	0.125	0.105	0.924	2.960	0.005	0.042	0.039	527.903	0.021	0.004
Rough Terrain Forklifts	2033	175	300	0.088	0.074	0.452	0.975	0.005	0.013	0.012	527.909	0.021	0.004
Rough Terrain Forklifts	2033	300	600	0.088	0.074	0.267	0.974	0.005	0.009	0.009	528.104	0.021	0.004
Rough Terrain Forklifts	2033	600	750	0.105	0.088	0.271	0.999	0.005	0.010	0.009	527.403	0.021	0.004
Rough Terrain Forklifts	2034	0	25	0.310	0.261	3.753	4.094	0.005	0.073	0.068	586.999	0.024	0.005
Rough Terrain Forklifts	2034	25	50	0.382	0.321	3.131	3.540	0.005	0.063	0.058	587.380	0.024	0.005
Rough Terrain Forklifts	2034	50	75	0.387	0.325	3.724	3.660	0.005	0.280	0.258	531.785	0.022	0.004
Rough Terrain Forklifts	2034	75	100	0.119	0.100	1.481	3.192	0.005	0.023	0.021	528.728	0.021	0.004
Rough Terrain Forklifts	2034	100	175	0.117	0.099	0.905	2.956	0.005	0.037	0.034	527.903	0.021	0.004
Rough Terrain Forklifts	2034	175	300	0.088	0.074	0.452	0.975	0.005	0.013	0.012	527.909	0.021	0.004
Rough Terrain Forklifts	2034	300	600	0.088	0.074	0.267	0.974	0.005	0.009	0.009	528.104	0.021	0.004
Rough Terrain Forklifts	2034	600	750	0.105	0.088	0.271	0.999	0.005	0.010	0.009	527.403	0.021	0.004
Rough Terrain Forklifts	2035	0	25	0.310	0.261	3.753	4.094	0.005	0.078	0.071	586.999	0.024	0.005
Rough Terrain Forklifts	2035	25	50	0.380	0.319	3.129	3.540	0.005	0.063	0.058	587.380	0.024	0.005
Rough Terrain Forklifts	2035	50	75	0.353	0.297	3.285	3.624	0.005	0.157	0.144	531.785	0.022	0.004
Rough Terrain Forklifts	2035	75	100	0.119	0.100	1.475	3.192	0.005	0.022	0.021	528.728	0.021	0.004
Rough Terrain Forklifts	2035	100	175	0.108	0.090	0.851	2.951	0.005	0.031	0.028	527.903	0.021	0.004
Rough Terrain Forklifts	2035	175	300	0.087	0.073	0.430	0.975	0.005	0.013	0.012	527.909	0.021	0.004
Rough Terrain Forklifts	2035	300	600	0.088	0.074	0.267	0.974	0.005	0.009	0.009	528.104	0.021	0.004
Rough Terrain Forklifts	2035	600	750	0.105	0.088	0.271	0.999	0.005	0.010	0.009	527.403	0.021	0.004
Rubber Tired Dozers	2025	25	50	0.628	0.528	3.679	5.181	0.005	0.127	0.117	586.987	0.024	0.005
Rubber Tired Dozers	2025	50	75	0.805	0.677	5.408	4.257	0.005	0.385	0.354	527.918	0.021	0.004
Rubber Tired Dozers	2025	75	100	0.704	0.591	4.915	4.156	0.005	0.355	0.327	531.632	0.022	0.004
Rubber Tired Dozers	2025	100	175	0.622	0.522	4.472	3.687	0.005	0.290	0.267	528.125	0.021	0.004
Rubber Tired Dozers	2025	175	300	0.511	0.430	4.599	2.585	0.005	0.201	0.185	528.560	0.021	0.004
Rubber Tired Dozers	2025	300	600	0.441	0.371	3.506	2.902	0.005	0.154	0.142	532.172	0.022	0.004
Rubber Tired Dozers	2025	600	750	0.276	0.232	2.871	1.100	0.005	0.081	0.075	527.876	0.021	0.004
Rubber Tired Dozers	2026	25	50	0.659	0.554	3.720	5.392	0.005	0.127	0.117	586.933	0.024	0.005
Rubber Tired Dozers	2026	50	75	0.765	0.643	5.010	4.213	0.005	0.369	0.339	527.921	0.021	0.004
Rubber Tired Dozers	2026	75	100	0.658	0.553	4.516	4.153	0.005	0.323	0.297	534.030	0.022	0.004
Rubber Tired Dozers	2026	100	175	0.516	0.434	3.706	3.575	0.005	0.220	0.202	528.033	0.021	0.004
Rubber Tired Dozers	2026	175	300	0.567	0.477	5.081	3.568	0.005	0.225	0.207	528.489	0.021	0.004
Rubber Tired Dozers	2026	300	600	0.420	0.353	3.223	2.726	0.005	0.142	0.131	532.550	0.022	0.004
Rubber Tired Dozers	2026	600	750	0.283	0.238	2.873	1.111	0.005	0.082	0.075	527.876	0.021	0.004
Rubber Tired Dozers	2027	25	50	0.619	0.520	3.689	5.497	0.005	0.111	0.102	586.953	0.024	0.005
Rubber Tired Dozers	2027	50	75	0.590	0.496	3.864	4.049	0.005	0.262	0.241	527.763	0.021	0.004
Rubber Tired Dozers	2027	75	100	0.570	0.479	3.979	4.108	0.005	0.260	0.240	534.108	0.022	0.004
Rubber Tired Dozers	2027	100	175	0.482	0.405	3.395	3.576	0.005	0.199	0.183	527.758	0.021	0.004
Rubber Tired Dozers	2027	175	300	0.529	0.444	4.623	3.477	0.005	0.205	0.189	528.479	0.021	0.004
Rubber Tired Dozers	2027	300	600	0.408	0.343	3.091	2.656	0.005	0.135	0.125	532.559	0.022	0.004
Rubber Tired Dozers	2027	600	750	0.288	0.242	2.874	1.119	0.005	0.082	0.075	527.876	0.021	0.004
Rubber Tired Dozers	2028	25	50	0.645	0.542	3.723	5.669	0.005	0.111	0.102	587.174	0.024	0.005
Rubber Tired Dozers	2028	50	75	0.566	0.476	3.636	4.056	0.005	0.244	0.225	527.594	0.021	0.004
Rubber Tired Dozers	2028	75	100	0.571	0.480	3.963	4.121	0.005	0.259	0.238	534.034	0.022	0.004
Rubber Tired Dozers	2028	100	175	0.397	0.334	2.575	3.535	0.005	0.150	0.138	528.372	0.021	0.004
Rubber Tired Dozers	2028	175	300	0.524	0.440	4.439	3.483	0.005	0.201	0.185	528.471	0.021	0.004
Rubber Tired Dozers	2028	300	600	0.407	0.342	3.041	2.663	0.005	0.134	0.123	532.858	0.022	0.004
Rubber Tired Dozers	2028	600	750	0.293	0.246	2.875	1.126	0.005	0.082	0.075	527.876	0.021	0.004
Rubber Tired Dozers	2029	25	50	0.647	0.543	3.684	5.727	0.005	0.100	0.092	587.167	0.024	0.005
Rubber Tired Dozers	2029	50	75	0.531	0.446	3.340	4.045	0.005	0.222	0.204	527.593	0.021	0.004
Rubber Tired Dozers	2029	75	100	0.519	0.436	3.602	4.085	0.005	0.227	0.209	534.980	0.022	0.004
Rubber Tired Dozers	2029	100	175	0.370	0.311	2.355	3.554	0.005	0.129	0.118	527.849	0.021	0.004
Rubber Tired Dozers	2029	175	300	0.525	0.441	4.439	3.487	0.005	0.201	0.185	528.442	0.021	0.004
Rubber Tired Dozers	2029	300	600	0.398	0.334	2.857	2.627	0.005	0.128	0.118	532.425	0.022	0.004

Unmitigated EFs from Caleemod 2022 (based on OFFROAD 2017) Appx G, Table G-11

Equipment	Year	Low HP	High HP	TOG	ROG	NOX	CO	SO2	PM10	PM2.5	CO2	CH4	N2O
Rubber Tired Dozers	2029	600	750	0.297	0.250	2.877	1.132	0.005	0.082	0.075	527.876	0.021	0.004
Rubber Tired Dozers	2030	25	50	0.612	0.514	3.679	5.693	0.005	0.095	0.087	587.167	0.024	0.005
Rubber Tired Dozers	2030	50	75	0.503	0.423	3.267	4.031	0.005	0.204	0.188	527.593	0.021	0.004
Rubber Tired Dozers	2030	75	100	0.465	0.391	3.249	4.061	0.005	0.194	0.179	534.980	0.022	0.004
Rubber Tired Dozers	2030	100	175	0.354	0.297	2.115	3.553	0.005	0.126	0.115	527.849	0.021	0.004
Rubber Tired Dozers	2030	175	300	0.413	0.347	3.460	2.393	0.005	0.147	0.135	528.517	0.021	0.004
Rubber Tired Dozers	2030	300	600	0.391	0.329	2.773	2.673	0.005	0.126	0.116	532.382	0.022	0.004
Rubber Tired Dozers	2030	600	750	0.297	0.250	2.877	1.132	0.005	0.082	0.075	527.876	0.021	0.004
Rubber Tired Dozers	2031	25	50	0.594	0.499	3.675	5.675	0.005	0.082	0.076	587.167	0.024	0.005
Rubber Tired Dozers	2031	50	75	0.489	0.411	3.171	4.024	0.005	0.198	0.182	527.593	0.021	0.004
Rubber Tired Dozers	2031	75	100	0.428	0.360	3.068	4.043	0.005	0.169	0.156	534.980	0.022	0.004
Rubber Tired Dozers	2031	100	175	0.347	0.291	1.975	3.553	0.005	0.122	0.112	527.849	0.021	0.004
Rubber Tired Dozers	2031	175	300	0.408	0.343	3.371	2.392	0.005	0.144	0.132	528.517	0.021	0.004
Rubber Tired Dozers	2031	300	600	0.385	0.323	2.665	2.605	0.005	0.124	0.114	532.382	0.022	0.004
Rubber Tired Dozers	2031	600	750	0.297	0.250	2.877	1.132	0.005	0.082	0.075	527.876	0.021	0.004
Rubber Tired Dozers	2032	25	50	0.569	0.478	3.671	5.652	0.005	0.060	0.055	587.167	0.024	0.005
Rubber Tired Dozers	2032	50	75	0.483	0.406	3.132	4.011	0.005	0.197	0.181	527.593	0.021	0.004
Rubber Tired Dozers	2032	75	100	0.403	0.338	2.769	4.031	0.005	0.148	0.136	534.980	0.022	0.004
Rubber Tired Dozers	2032	100	175	0.340	0.285	1.869	3.544	0.005	0.119	0.109	527.849	0.021	0.004
Rubber Tired Dozers	2032	175	300	0.482	0.405	4.051	3.437	0.005	0.180	0.165	528.442	0.021	0.004
Rubber Tired Dozers	2032	300	600	0.360	0.303	2.414	2.328	0.005	0.109	0.101	532.425	0.022	0.004
Rubber Tired Dozers	2032	600	750	0.285	0.240	2.278	1.132	0.005	0.068	0.062	527.876	0.021	0.004
Rubber Tired Dozers	2033	25	50	0.564	0.474	3.670	5.647	0.005	0.055	0.050	587.167	0.024	0.005
Rubber Tired Dozers	2033	50	75	0.422	0.354	2.722	3.981	0.005	0.152	0.140	527.593	0.021	0.004
Rubber Tired Dozers	2033	75	100	0.399	0.335	2.751	4.029	0.005	0.147	0.135	534.980	0.022	0.004
Rubber Tired Dozers	2033	100	175	0.340	0.285	1.869	3.544	0.005	0.119	0.109	527.849	0.021	0.004
Rubber Tired Dozers	2033	175	300	0.476	0.400	3.960	3.437	0.005	0.175	0.161	528.442	0.021	0.004
Rubber Tired Dozers	2033	300	600	0.350	0.294	2.278	2.153	0.005	0.102	0.094	532.425	0.022	0.004
Rubber Tired Dozers	2033	600	750	0.278	0.234	2.076	1.132	0.005	0.063	0.058	527.876	0.021	0.004
Rubber Tired Dozers	2034	25	50	0.564	0.474	3.670	5.647	0.005	0.055	0.051	587.167	0.024	0.005
Rubber Tired Dozers	2034	50	75	0.406	0.341	2.680	3.973	0.005	0.142	0.131	527.593	0.021	0.004
Rubber Tired Dozers	2034	75	100	0.392	0.329	2.596	4.027	0.005	0.135	0.124	534.980	0.022	0.004
Rubber Tired Dozers	2034	100	175	0.331	0.278	1.811	3.544	0.005	0.113	0.104	527.849	0.021	0.004
Rubber Tired Dozers	2034	175	300	0.471	0.396	3.885	3.423	0.005	0.173	0.159	528.442	0.021	0.004
Rubber Tired Dozers	2034	300	600	0.342	0.287	2.207	2.116	0.005	0.097	0.089	532.425	0.022	0.004
Rubber Tired Dozers	2034	600	750	0.277	0.233	1.975	1.132	0.005	0.062	0.057	527.876	0.021	0.004
Rubber Tired Dozers	2035	25	50	0.563	0.473	3.670	5.647	0.005	0.057	0.052	587.167	0.024	0.005
Rubber Tired Dozers	2035	50	75	0.398	0.334	2.659	3.969	0.005	0.137	0.126	527.593	0.021	0.004
Rubber Tired Dozers	2035	75	100	0.386	0.325	2.492	4.025	0.005	0.127	0.117	534.980	0.022	0.004
Rubber Tired Dozers	2035	100	175	0.319	0.268	1.742	3.527	0.005	0.102	0.094	527.849	0.021	0.004
Rubber Tired Dozers	2035	175	300	0.466	0.392	3.748	3.411	0.005	0.171	0.157	528.442	0.021	0.004
Rubber Tired Dozers	2035	300	600	0.326	0.274	2.032	1.961	0.005	0.088	0.081	532.425	0.022	0.004
Rubber Tired Dozers	2035	600	750	0.277	0.233	1.975	1.132	0.005	0.062	0.057	527.876	0.021	0.004
Rubber Tired Loaders	2025	0	25	1.026	0.848	6.486	3.503	0.011	0.242	0.223	850.791	0.035	0.007
Rubber Tired Loaders	2025	25	50	1.148	0.965	4.369	5.969	0.005	0.260	0.239	588.750	0.024	0.005
Rubber Tired Loaders	2025	50	75	2.322	1.951	15.449	6.324	0.005	1.133	1.042	528.023	0.021	0.004
Rubber Tired Loaders	2025	75	100	0.415	0.349	2.946	3.790	0.005	0.177	0.163	522.879	0.021	0.004
Rubber Tired Loaders	2025	100	175	0.268	0.225	1.602	3.283	0.005	0.085	0.078	526.161	0.021	0.004
Rubber Tired Loaders	2025	175	300	0.213	0.179	1.492	1.160	0.005	0.050	0.046	526.675	0.021	0.004
Rubber Tired Loaders	2025	300	600	0.234	0.197	1.459	1.261	0.005	0.055	0.050	527.135	0.021	0.004
Rubber Tired Loaders	2025	600	750	0.240	0.202	1.253	1.574	0.005	0.046	0.042	526.188	0.021	0.004
Rubber Tired Loaders	2025	750	999	0.226	0.190	3.418	1.122	0.005	0.064	0.059	529.003	0.021	0.004
Rubber Tired Loaders	2026	0	25	1.026	0.848	6.482	3.501	0.011	0.242	0.223	850.265	0.034	0.007
Rubber Tired Loaders	2026	25	50	1.038	0.872	4.148	5.780	0.005	0.215	0.198	588.570	0.024	0.005
Rubber Tired Loaders	2026	50	75	2.322	1.951	15.449	6.324	0.005	1.133	1.042	528.023	0.021	0.004
Rubber Tired Loaders	2026	75	100	0.387	0.325	2.722	3.785	0.005	0.153	0.141	523.446	0.021	0.004
Rubber Tired Loaders	2026	100	175	0.252	0.211	1.398	3.293	0.005	0.073	0.067	526.415	0.021	0.004
Rubber Tired Loaders	2026	175	300	0.208	0.175	1.337	1.166	0.005	0.045	0.041	526.593	0.021	0.004
Rubber Tired Loaders	2026	300	600	0.222	0.187	1.303	1.235	0.005	0.049	0.045	527.198	0.021	0.004
Rubber Tired Loaders	2026	600	750	0.233	0.196	1.134	1.476	0.005	0.040	0.037	526.611	0.021	0.004
Rubber Tired Loaders	2026	750	999	0.224	0.188	3.414	1.120	0.005	0.064	0.058	529.048	0.021	0.004
Rubber Tired Loaders	2027	0	25	1.027	0.849	6.491	3.506	0.011	0.243	0.223	851.426	0.035	0.007
Rubber Tired Loaders	2027	25	50	1.004	0.844	4.103	5.801	0.005	0.203	0.186	588.202	0.024	0.005
Rubber Tired Loaders	2027	50	75	1.893	1.590	12.460	5.302	0.005	1.012	0.931	527.014	0.021	0.004
Rubber Tired Loaders	2027	75	100	0.356	0.299	2.498	3.774	0.005	0.128	0.117	522.846	0.021	0.004
Rubber Tired Loaders	2027	100	175	0.239	0.200	1.240	3.304	0.005	0.063	0.058	526.609	0.021	0.004

Unmitigated EFs from Caleemod 2022 (based on OFFROAD 2017) Appx G, Table G-11

Equipment	Year	Low HP	High HP	TOG	ROG	NOX	CO	SO2	PM10	PM2.5	CO2	CH4	N2O
Rubber Tired Loaders	2027	175	300	0.190	0.160	1.076	1.148	0.005	0.037	0.034	526.664	0.021	0.004
Rubber Tired Loaders	2027	300	600	0.223	0.188	1.203	1.246	0.005	0.046	0.042	527.657	0.021	0.004
Rubber Tired Loaders	2027	600	750	0.210	0.177	0.943	1.206	0.005	0.030	0.027	526.885	0.021	0.004
Rubber Tired Loaders	2027	750	999	0.231	0.194	3.432	1.131	0.005	0.064	0.059	529.084	0.021	0.004
Rubber Tired Loaders	2028	0	25	1.041	0.862	6.449	3.710	0.010	0.265	0.243	834.804	0.034	0.007
Rubber Tired Loaders	2028	25	50	0.955	0.802	3.972	5.679	0.005	0.179	0.164	586.978	0.024	0.005
Rubber Tired Loaders	2028	50	75	1.655	1.390	9.088	4.750	0.005	1.042	0.958	537.020	0.022	0.004
Rubber Tired Loaders	2028	75	100	0.328	0.275	2.310	3.771	0.005	0.103	0.094	523.539	0.021	0.004
Rubber Tired Loaders	2028	100	175	0.227	0.191	1.098	3.317	0.005	0.054	0.050	527.104	0.021	0.004
Rubber Tired Loaders	2028	175	300	0.187	0.157	0.964	1.151	0.005	0.033	0.031	526.776	0.021	0.004
Rubber Tired Loaders	2028	300	600	0.222	0.187	1.137	1.236	0.005	0.043	0.040	527.230	0.021	0.004
Rubber Tired Loaders	2028	600	750	0.215	0.180	0.840	1.233	0.005	0.027	0.025	526.022	0.021	0.004
Rubber Tired Loaders	2028	750	999	0.239	0.201	3.453	1.143	0.005	0.065	0.059	529.085	0.021	0.004
Rubber Tired Loaders	2029	0	25	1.041	0.862	6.443	3.718	0.010	0.266	0.244	833.523	0.034	0.007
Rubber Tired Loaders	2029	25	50	0.905	0.761	3.910	5.691	0.005	0.159	0.146	588.052	0.024	0.005
Rubber Tired Loaders	2029	50	75	1.657	1.392	9.182	4.753	0.005	1.037	0.954	535.625	0.022	0.004
Rubber Tired Loaders	2029	75	100	0.324	0.272	2.237	3.789	0.005	0.095	0.087	523.887	0.021	0.004
Rubber Tired Loaders	2029	100	175	0.219	0.184	0.977	3.332	0.005	0.048	0.044	527.249	0.021	0.004
Rubber Tired Loaders	2029	175	300	0.189	0.158	0.906	1.177	0.005	0.032	0.029	526.689	0.021	0.004
Rubber Tired Loaders	2029	300	600	0.219	0.184	1.063	1.212	0.005	0.040	0.037	526.628	0.021	0.004
Rubber Tired Loaders	2029	600	750	0.213	0.179	0.711	1.203	0.005	0.023	0.021	525.807	0.021	0.004
Rubber Tired Loaders	2029	750	999	0.216	0.182	3.125	1.140	0.005	0.052	0.048	529.063	0.021	0.004
Rubber Tired Loaders	2030	0	25	1.020	0.844	6.439	3.696	0.010	0.263	0.242	833.484	0.034	0.007
Rubber Tired Loaders	2030	25	50	0.882	0.741	3.883	5.657	0.005	0.153	0.141	588.052	0.024	0.005
Rubber Tired Loaders	2030	50	75	1.271	1.068	7.838	4.566	0.005	0.809	0.744	535.625	0.022	0.004
Rubber Tired Loaders	2030	75	100	0.314	0.264	2.166	3.784	0.005	0.087	0.080	523.887	0.021	0.004
Rubber Tired Loaders	2030	100	175	0.212	0.178	0.903	3.332	0.005	0.045	0.042	527.249	0.021	0.004
Rubber Tired Loaders	2030	175	300	0.186	0.156	0.851	1.174	0.005	0.030	0.028	526.689	0.021	0.004
Rubber Tired Loaders	2030	300	600	0.215	0.180	0.972	1.195	0.005	0.038	0.035	526.628	0.021	0.004
Rubber Tired Loaders	2030	600	750	0.210	0.176	0.674	1.203	0.005	0.023	0.021	525.807	0.021	0.004
Rubber Tired Loaders	2030	750	999	0.206	0.173	3.000	1.093	0.005	0.047	0.044	529.063	0.021	0.004
Rubber Tired Loaders	2031	0	25	1.020	0.844	6.437	3.694	0.010	0.262	0.241	833.183	0.034	0.007
Rubber Tired Loaders	2031	25	50	0.844	0.709	3.874	5.620	0.005	0.146	0.134	588.052	0.024	0.005
Rubber Tired Loaders	2031	50	75	1.141	0.959	7.502	4.502	0.005	0.726	0.668	535.625	0.022	0.004
Rubber Tired Loaders	2031	75	100	0.300	0.252	2.057	3.776	0.005	0.078	0.071	523.887	0.021	0.004
Rubber Tired Loaders	2031	100	175	0.207	0.174	0.829	3.331	0.005	0.043	0.040	527.249	0.021	0.004
Rubber Tired Loaders	2031	175	300	0.184	0.155	0.799	1.156	0.005	0.029	0.027	526.689	0.021	0.004
Rubber Tired Loaders	2031	300	600	0.213	0.179	0.918	1.194	0.005	0.038	0.035	526.628	0.021	0.004
Rubber Tired Loaders	2031	600	750	0.205	0.172	0.547	1.194	0.005	0.022	0.020	525.807	0.021	0.004
Rubber Tired Loaders	2031	750	999	0.204	0.172	2.963	1.093	0.005	0.046	0.043	529.063	0.021	0.004
Rubber Tired Loaders	2032	0	25	0.999	0.826	6.438	3.676	0.010	0.243	0.223	833.804	0.034	0.007
Rubber Tired Loaders	2032	25	50	0.795	0.668	3.800	5.573	0.005	0.133	0.123	588.052	0.024	0.005
Rubber Tired Loaders	2032	50	75	1.075	0.904	7.334	4.467	0.005	0.686	0.631	535.625	0.022	0.004
Rubber Tired Loaders	2032	75	100	0.292	0.246	1.978	3.773	0.005	0.071	0.066	523.887	0.021	0.004
Rubber Tired Loaders	2032	100	175	0.203	0.170	0.762	3.330	0.005	0.041	0.037	527.249	0.021	0.004
Rubber Tired Loaders	2032	175	300	0.181	0.152	0.737	1.153	0.005	0.027	0.025	526.689	0.021	0.004
Rubber Tired Loaders	2032	300	600	0.210	0.176	0.854	1.174	0.005	0.035	0.032	526.628	0.021	0.004
Rubber Tired Loaders	2032	600	750	0.205	0.172	0.547	1.194	0.005	0.022	0.020	525.807	0.021	0.004
Rubber Tired Loaders	2032	750	999	0.201	0.169	2.895	1.093	0.005	0.044	0.041	529.063	0.021	0.004
Rubber Tired Loaders	2033	0	25	0.998	0.826	6.435	3.674	0.010	0.243	0.223	833.503	0.034	0.007
Rubber Tired Loaders	2033	25	50	0.768	0.646	3.751	5.541	0.005	0.123	0.113	588.052	0.024	0.005
Rubber Tired Loaders	2033	50	75	1.075	0.904	7.334	4.467	0.005	0.686	0.631	535.625	0.022	0.004
Rubber Tired Loaders	2033	75	100	0.285	0.239	1.911	3.770	0.005	0.065	0.059	523.887	0.021	0.004
Rubber Tired Loaders	2033	100	175	0.199	0.168	0.725	3.330	0.005	0.038	0.035	527.249	0.021	0.004
Rubber Tired Loaders	2033	175	300	0.178	0.150	0.691	1.152	0.005	0.026	0.024	526.689	0.021	0.004
Rubber Tired Loaders	2033	300	600	0.207	0.174	0.802	1.165	0.005	0.033	0.030	526.628	0.021	0.004
Rubber Tired Loaders	2033	600	750	0.205	0.172	0.547	1.194	0.005	0.022	0.020	525.807	0.021	0.004
Rubber Tired Loaders	2033	750	999	0.199	0.168	2.861	1.093	0.005	0.043	0.040	529.063	0.021	0.004
Rubber Tired Loaders	2034	0	25	0.999	0.826	6.437	3.675	0.010	0.243	0.223	833.722	0.034	0.007
Rubber Tired Loaders	2034	25	50	0.717	0.603	3.668	5.485	0.005	0.109	0.100	588.052	0.024	0.005
Rubber Tired Loaders	2034	50	75	0.825	0.693	5.486	4.332	0.005	0.506	0.466	535.625	0.022	0.004
Rubber Tired Loaders	2034	75	100	0.283	0.237	1.891	3.769	0.005	0.062	0.057	523.887	0.021	0.004
Rubber Tired Loaders	2034	100	175	0.196	0.164	0.689	3.329	0.005	0.035	0.033	527.249	0.021	0.004
Rubber Tired Loaders	2034	175	300	0.176	0.148	0.649	1.151	0.005	0.024	0.022	526.689	0.021	0.004
Rubber Tired Loaders	2034	300	600	0.202	0.170	0.738	1.155	0.005	0.028	0.026	526.628	0.021	0.004
Rubber Tired Loaders	2034	600	750	0.205	0.172	0.544	1.194	0.005	0.022	0.020	525.807	0.021	0.004

Unmitigated EFs from Caleemod 2022 (based on OFFROAD 2017) Appx G, Table G-11

Equipment	Year	Low HP	High HP	TOG	ROG	NOX	CO	SO2	PM10	PM2.5	CO2	CH4	N2O
Rubber Tired Loaders	2034	750	999	0.196	0.164	2.727	1.093	0.005	0.039	0.036	529.063	0.021	0.004
Rubber Tired Loaders	2035	0	25	0.998	0.825	6.433	3.672	0.010	0.243	0.224	833.178	0.034	0.007
Rubber Tired Loaders	2035	25	50	0.679	0.570	3.642	5.447	0.005	0.098	0.090	588.052	0.024	0.005
Rubber Tired Loaders	2035	50	75	0.765	0.643	5.332	4.303	0.005	0.468	0.431	535.625	0.022	0.004
Rubber Tired Loaders	2035	75	100	0.277	0.233	1.845	3.766	0.005	0.055	0.051	523.887	0.021	0.004
Rubber Tired Loaders	2035	100	175	0.192	0.161	0.660	3.328	0.005	0.032	0.030	527.249	0.021	0.004
Rubber Tired Loaders	2035	175	300	0.173	0.146	0.605	1.148	0.005	0.022	0.021	526.689	0.021	0.004
Rubber Tired Loaders	2035	300	600	0.197	0.166	0.681	1.150	0.005	0.025	0.023	526.628	0.021	0.004
Rubber Tired Loaders	2035	600	750	0.205	0.172	0.537	1.194	0.005	0.022	0.020	525.807	0.021	0.004
Rubber Tired Loaders	2035	750	999	0.195	0.164	2.657	1.093	0.005	0.037	0.034	529.063	0.021	0.004
Scrapers	2025	0	25	0.233	0.196	2.926	3.579	0.005	0.012	0.011	586.963	0.024	0.005
Scrapers	2025	25	50	4.088	3.435	6.761	9.663	0.005	0.953	0.877	577.150	0.023	0.005
Scrapers	2025	50	75	0.701	0.589	4.650	3.892	0.005	0.372	0.343	531.265	0.022	0.004
Scrapers	2025	75	100	0.642	0.539	5.506	4.035	0.005	0.399	0.367	530.077	0.022	0.004
Scrapers	2025	100	175	0.360	0.303	2.737	3.357	0.005	0.142	0.131	531.820	0.022	0.004
Scrapers	2025	175	300	0.336	0.283	2.714	1.735	0.005	0.123	0.113	527.149	0.021	0.004
Scrapers	2025	300	600	0.243	0.204	1.909	1.576	0.005	0.074	0.068	528.942	0.021	0.004
Scrapers	2025	600	750	0.330	0.277	3.468	2.993	0.005	0.143	0.131	527.905	0.021	0.004
Scrapers	2025	750	999	0.499	0.420	5.970	4.055	0.005	0.205	0.189	527.722	0.021	0.004
Scrapers	2026	0	25	0.257	0.216	2.959	3.738	0.005	0.012	0.011	586.963	0.024	0.005
Scrapers	2026	25	50	4.107	3.451	6.771	9.704	0.005	0.957	0.880	577.150	0.023	0.005
Scrapers	2026	50	75	0.734	0.617	4.929	3.954	0.005	0.399	0.367	528.761	0.021	0.004
Scrapers	2026	75	100	0.573	0.482	4.959	3.954	0.005	0.351	0.323	529.585	0.021	0.004
Scrapers	2026	100	175	0.323	0.272	2.404	3.276	0.005	0.125	0.115	531.008	0.022	0.004
Scrapers	2026	175	300	0.331	0.278	2.582	1.562	0.005	0.116	0.106	527.080	0.021	0.004
Scrapers	2026	300	600	0.233	0.196	1.741	1.539	0.005	0.068	0.062	528.854	0.021	0.004
Scrapers	2026	600	750	0.316	0.266	3.232	2.908	0.005	0.134	0.124	527.106	0.021	0.004
Scrapers	2026	750	999	0.504	0.423	5.976	4.061	0.005	0.206	0.189	527.722	0.021	0.004
Scrapers	2027	0	25	0.280	0.235	2.991	3.893	0.005	0.013	0.012	586.963	0.024	0.005
Scrapers	2027	25	50	4.108	3.452	6.772	9.708	0.005	0.957	0.881	577.150	0.023	0.005
Scrapers	2027	50	75	0.540	0.453	3.799	3.762	0.005	0.271	0.250	528.713	0.021	0.004
Scrapers	2027	75	100	0.489	0.411	4.425	3.870	0.005	0.289	0.266	530.862	0.022	0.004
Scrapers	2027	100	175	0.304	0.256	2.181	3.256	0.005	0.113	0.104	530.743	0.022	0.004
Scrapers	2027	175	300	0.311	0.261	2.300	1.520	0.005	0.105	0.096	527.229	0.021	0.004
Scrapers	2027	300	600	0.227	0.191	1.609	1.522	0.005	0.063	0.058	528.705	0.021	0.004
Scrapers	2027	600	750	0.377	0.317	3.987	3.447	0.005	0.168	0.154	528.237	0.021	0.004
Scrapers	2027	750	999	0.508	0.427	5.981	4.068	0.005	0.206	0.190	527.868	0.021	0.004
Scrapers	2028	0	25	0.303	0.254	3.022	4.043	0.005	0.013	0.012	586.963	0.024	0.005
Scrapers	2028	25	50	4.108	3.452	6.772	9.708	0.005	0.957	0.881	577.150	0.023	0.005
Scrapers	2028	50	75	0.483	0.406	3.459	3.723	0.005	0.225	0.207	527.315	0.021	0.004
Scrapers	2028	75	100	0.296	0.249	2.776	3.515	0.005	0.140	0.129	528.866	0.021	0.004
Scrapers	2028	100	175	0.287	0.241	1.984	3.254	0.005	0.102	0.094	531.054	0.022	0.004
Scrapers	2028	175	300	0.308	0.259	2.225	1.513	0.005	0.102	0.094	526.984	0.021	0.004
Scrapers	2028	300	600	0.220	0.185	1.493	1.500	0.005	0.059	0.054	528.609	0.021	0.004
Scrapers	2028	600	750	0.337	0.283	3.250	3.345	0.005	0.146	0.134	528.037	0.021	0.004
Scrapers	2028	750	999	0.512	0.430	5.980	4.072	0.005	0.206	0.190	527.576	0.021	0.004
Scrapers	2029	0	25	0.325	0.273	3.052	4.189	0.005	0.014	0.013	586.963	0.024	0.005
Scrapers	2029	25	50	4.108	3.452	6.772	9.708	0.005	0.957	0.881	577.150	0.023	0.005
Scrapers	2029	50	75	0.407	0.342	3.108	3.697	0.005	0.163	0.150	526.992	0.021	0.004
Scrapers	2029	75	100	0.291	0.244	2.710	3.515	0.005	0.134	0.123	529.056	0.021	0.004
Scrapers	2029	100	175	0.283	0.238	1.904	3.268	0.005	0.097	0.090	530.967	0.022	0.004
Scrapers	2029	175	300	0.307	0.258	2.158	1.511	0.005	0.099	0.091	527.122	0.021	0.004
Scrapers	2029	300	600	0.213	0.179	1.374	1.469	0.005	0.055	0.050	528.521	0.021	0.004
Scrapers	2029	600	750	0.967	0.813	10.343	8.763	0.005	0.466	0.429	527.724	0.021	0.004
Scrapers	2029	750	999	0.471	0.396	5.605	3.625	0.005	0.186	0.171	528.007	0.021	0.004
Scrapers	2030	0	25	0.325	0.273	3.052	4.189	0.005	0.014	0.013	586.963	0.024	0.005
Scrapers	2030	25	50	4.108	3.452	6.772	9.708	0.005	0.957	0.881	577.150	0.023	0.005
Scrapers	2030	50	75	0.390	0.327	2.929	3.663	0.005	0.155	0.143	526.992	0.021	0.004
Scrapers	2030	75	100	0.268	0.225	2.646	3.504	0.005	0.117	0.108	529.056	0.021	0.004
Scrapers	2030	100	175	0.278	0.233	1.812	3.287	0.005	0.096	0.089	531.173	0.022	0.004
Scrapers	2030	175	300	0.285	0.239	1.941	1.557	0.005	0.090	0.083	527.152	0.021	0.004
Scrapers	2030	300	600	0.208	0.175	1.281	1.454	0.005	0.053	0.049	528.521	0.021	0.004
Scrapers	2030	600	750	0.803	0.674	8.518	3.033	0.005	0.354	0.325	527.724	0.021	0.004
Scrapers	2030	750	999	0.467	0.392	5.393	3.625	0.005	0.182	0.167	528.007	0.021	0.004
Scrapers	2031	0	25	0.325	0.273	3.052	4.189	0.005	0.014	0.013	586.963	0.024	0.005
Scrapers	2031	25	50	4.108	3.452	6.772	9.708	0.005	0.957	0.881	577.150	0.023	0.005

Unmitigated EFs from Caleemod 2022 (based on OFFROAD 2017) Appx G, Table G-11

Equipment	Year	Low HP	High HP	TOG	ROG	NOX	CO	SO2	PM10	PM2.5	CO2	CH4	N2O
Scrapers	2031	50	75	0.390	0.327	2.929	3.663	0.005	0.152	0.140	526.992	0.021	0.004
Scrapers	2031	75	100	0.251	0.211	2.442	3.496	0.005	0.104	0.095	529.056	0.021	0.004
Scrapers	2031	100	175	0.238	0.200	1.434	3.245	0.005	0.076	0.070	531.071	0.022	0.004
Scrapers	2031	175	300	0.303	0.255	2.065	1.542	0.005	0.101	0.093	527.147	0.021	0.004
Scrapers	2031	300	600	0.204	0.172	1.196	1.446	0.005	0.051	0.047	528.521	0.021	0.004
Scrapers	2031	600	750	0.803	0.674	8.518	3.033	0.005	0.354	0.325	527.724	0.021	0.004
Scrapers	2031	750	999	0.458	0.385	5.260	3.620	0.005	0.181	0.166	528.007	0.021	0.004
Scrapers	2032	0	25	0.325	0.273	3.052	4.189	0.005	0.014	0.013	586.963	0.024	0.005
Scrapers	2032	25	50	3.410	2.865	6.577	9.031	0.005	0.863	0.794	577.150	0.023	0.005
Scrapers	2032	50	75	0.387	0.325	2.884	3.663	0.005	0.152	0.140	526.992	0.021	0.004
Scrapers	2032	75	100	0.244	0.205	2.287	3.492	0.005	0.095	0.087	529.056	0.021	0.004
Scrapers	2032	100	175	0.251	0.211	1.541	3.255	0.005	0.084	0.077	530.967	0.022	0.004
Scrapers	2032	175	300	0.280	0.235	1.822	1.467	0.005	0.087	0.080	527.122	0.021	0.004
Scrapers	2032	300	600	0.200	0.168	1.132	1.433	0.005	0.049	0.045	528.521	0.021	0.004
Scrapers	2032	600	750	0.797	0.669	8.213	3.033	0.005	0.346	0.319	527.724	0.021	0.004
Scrapers	2032	750	999	0.457	0.384	5.171	3.620	0.005	0.180	0.166	528.007	0.021	0.004
Scrapers	2033	0	25	0.325	0.273	3.052	4.189	0.005	0.014	0.013	586.963	0.024	0.005
Scrapers	2033	25	50	3.177	2.669	6.539	8.806	0.005	0.833	0.767	577.150	0.023	0.005
Scrapers	2033	50	75	0.387	0.325	2.884	3.663	0.005	0.153	0.141	526.992	0.021	0.004
Scrapers	2033	75	100	0.235	0.198	2.116	3.489	0.005	0.088	0.081	529.056	0.021	0.004
Scrapers	2033	100	175	0.238	0.200	1.384	3.253	0.005	0.074	0.068	531.292	0.022	0.004
Scrapers	2033	175	300	0.277	0.233	1.771	1.574	0.005	0.086	0.079	527.175	0.021	0.004
Scrapers	2033	300	600	0.196	0.165	1.073	1.423	0.005	0.045	0.042	528.521	0.021	0.004
Scrapers	2033	600	750	0.793	0.666	8.110	3.033	0.005	0.344	0.316	527.724	0.021	0.004
Scrapers	2033	750	999	0.457	0.384	4.693	3.620	0.005	0.164	0.151	528.007	0.021	0.004
Scrapers	2034	0	25	0.325	0.273	3.052	4.189	0.005	0.014	0.013	586.963	0.024	0.005
Scrapers	2034	25	50	2.559	2.150	6.381	8.203	0.005	0.749	0.689	577.150	0.023	0.005
Scrapers	2034	50	75	0.386	0.324	2.870	3.663	0.005	0.148	0.136	526.992	0.021	0.004
Scrapers	2034	75	100	0.235	0.198	2.116	3.489	0.005	0.089	0.082	529.056	0.021	0.004
Scrapers	2034	100	175	0.230	0.193	1.334	3.251	0.005	0.071	0.065	531.292	0.022	0.004
Scrapers	2034	175	300	0.270	0.227	1.683	1.562	0.005	0.082	0.076	527.175	0.021	0.004
Scrapers	2034	300	600	0.190	0.160	1.004	1.415	0.005	0.041	0.037	528.521	0.021	0.004
Scrapers	2034	600	750	0.792	0.666	8.059	3.033	0.005	0.343	0.316	527.724	0.021	0.004
Scrapers	2034	750	999	0.445	0.374	4.541	3.474	0.005	0.159	0.146	528.007	0.021	0.004
Scrapers	2035	0	25	0.325	0.273	3.052	4.189	0.005	0.014	0.013	586.963	0.024	0.005
Scrapers	2035	25	50	2.377	1.997	6.339	8.041	0.005	0.728	0.670	577.150	0.023	0.005
Scrapers	2035	50	75	0.428	0.360	3.153	3.744	0.005	0.168	0.154	526.774	0.021	0.004
Scrapers	2035	75	100	0.229	0.192	2.061	3.481	0.005	0.076	0.070	529.019	0.021	0.004
Scrapers	2035	100	175	0.224	0.188	1.299	3.253	0.005	0.066	0.061	531.258	0.022	0.004
Scrapers	2035	175	300	0.265	0.223	1.619	1.540	0.005	0.080	0.073	527.166	0.021	0.004
Scrapers	2035	300	600	0.185	0.156	0.949	1.406	0.005	0.038	0.035	528.521	0.021	0.004
Scrapers	2035	600	750	0.784	0.659	7.767	3.033	0.005	0.338	0.311	527.724	0.021	0.004
Scrapers	2035	750	999	0.444	0.373	4.351	3.474	0.005	0.153	0.141	528.007	0.021	0.004
Signal Boards	2025	0	25	0.662	0.547	4.143	3.470	0.009	0.162	0.149	568.302	0.023	0.005
Signal Boards	2025	25	50	0.517	0.427	3.525	4.174	0.007	0.097	0.090	562.457	0.023	0.005
Signal Boards	2026	0	25	0.662	0.547	4.143	3.470	0.009	0.162	0.149	568.302	0.023	0.005
Signal Boards	2026	25	50	0.482	0.398	3.418	4.135	0.007	0.082	0.076	560.870	0.023	0.005
Signal Boards	2027	0	25	0.662	0.547	4.143	3.470	0.009	0.162	0.149	568.298	0.023	0.005
Signal Boards	2027	25	50	0.451	0.373	3.316	4.098	0.007	0.068	0.063	559.515	0.023	0.005
Signal Boards	2028	0	25	0.662	0.547	4.143	3.470	0.009	0.162	0.149	568.300	0.023	0.005
Signal Boards	2028	25	50	0.426	0.352	3.235	4.079	0.007	0.055	0.051	560.388	0.023	0.005
Signal Boards	2029	0	25	0.662	0.547	4.143	3.470	0.009	0.162	0.149	568.300	0.023	0.005
Signal Boards	2029	25	50	0.403	0.333	3.171	4.043	0.007	0.046	0.042	558.178	0.023	0.005
Signal Boards	2030	0	25	0.662	0.547	4.143	3.470	0.009	0.162	0.149	568.301	0.023	0.005
Signal Boards	2030	25	50	0.386	0.319	3.137	4.026	0.007	0.040	0.036	558.156	0.023	0.005
Signal Boards	2031	0	25	0.662	0.547	4.143	3.470	0.009	0.162	0.149	568.298	0.023	0.005
Signal Boards	2031	25	50	0.374	0.309	3.109	4.016	0.007	0.034	0.031	558.310	0.023	0.005
Signal Boards	2032	0	25	0.662	0.547	4.143	3.470	0.009	0.162	0.149	568.303	0.023	0.005
Signal Boards	2032	25	50	0.364	0.300	3.077	3.998	0.007	0.029	0.027	557.079	0.023	0.005
Signal Boards	2033	0	25	0.662	0.547	4.143	3.470	0.009	0.162	0.149	568.298	0.023	0.005
Signal Boards	2033	25	50	0.357	0.295	3.054	3.991	0.007	0.026	0.023	556.900	0.023	0.005
Signal Boards	2034	0	25	0.662	0.547	4.143	3.470	0.009	0.162	0.149	568.301	0.023	0.005
Signal Boards	2034	25	50	0.352	0.291	3.039	3.991	0.007	0.022	0.021	557.398	0.023	0.005
Signal Boards	2035	0	25	0.662	0.547	4.143	3.470	0.009	0.162	0.149	568.300	0.023	0.005
Signal Boards	2035	25	50	0.349	0.289	3.017	3.980	0.007	0.020	0.018	556.059	0.023	0.005
Skid Steer Loaders	2025	0	25	1.025	0.847	6.486	3.493	0.011	0.248	0.228	848.214	0.034	0.007

Unmitigated EFs from Caleemod 2022 (based on OFFROAD 2017) Appx G, Table G-11

Equipment	Year	Low HP	High HP	TOG	ROG	NOX	CO	SO2	PM10	PM2.5	CO2	CH4	N2O
Skid Steer Loaders	2025	25	50	0.405	0.341	3.302	3.652	0.005	0.084	0.077	589.204	0.024	0.005
Skid Steer Loaders	2025	50	75	0.166	0.139	1.862	3.249	0.005	0.056	0.052	528.374	0.021	0.004
Skid Steer Loaders	2025	75	100	2.064	1.734	14.404	5.850	0.005	0.968	0.891	528.023	0.021	0.004
Skid Steer Loaders	2025	100	175	0.130	0.109	1.005	2.878	0.005	0.039	0.036	527.077	0.021	0.004
Skid Steer Loaders	2025	175	300	0.129	0.108	1.195	0.995	0.005	0.037	0.034	528.013	0.021	0.004
Skid Steer Loaders	2025	300	600	0.201	0.169	2.089	1.001	0.005	0.092	0.084	528.537	0.021	0.004
Skid Steer Loaders	2025	600	750	0.201	0.169	2.089	1.001	0.005	0.092	0.084	528.537	0.021	0.004
Skid Steer Loaders	2025	750	999	0.090	0.076	2.290	0.955	0.005	0.030	0.028	527.040	0.021	0.004
Skid Steer Loaders	2026	0	25	1.024	0.846	6.478	3.493	0.011	0.246	0.227	848.222	0.034	0.007
Skid Steer Loaders	2026	25	50	0.394	0.331	3.266	3.614	0.005	0.080	0.073	588.646	0.024	0.005
Skid Steer Loaders	2026	50	75	0.159	0.134	1.807	3.245	0.005	0.051	0.047	528.621	0.021	0.004
Skid Steer Loaders	2026	75	100	2.074	1.743	14.444	5.868	0.005	0.975	0.897	528.023	0.021	0.004
Skid Steer Loaders	2026	100	175	0.131	0.110	1.009	2.891	0.005	0.039	0.036	528.071	0.021	0.004
Skid Steer Loaders	2026	175	300	0.119	0.100	1.021	0.992	0.005	0.029	0.027	528.075	0.021	0.004
Skid Steer Loaders	2026	300	600	0.204	0.172	2.093	1.004	0.005	0.092	0.085	528.537	0.021	0.004
Skid Steer Loaders	2026	600	750	0.204	0.172	2.093	1.004	0.005	0.092	0.085	528.537	0.021	0.004
Skid Steer Loaders	2026	750	999	0.093	0.078	2.298	0.960	0.005	0.030	0.028	527.040	0.021	0.004
Skid Steer Loaders	2027	0	25	1.024	0.846	6.473	3.492	0.011	0.245	0.225	848.199	0.034	0.007
Skid Steer Loaders	2027	25	50	0.384	0.323	3.232	3.595	0.005	0.075	0.069	588.573	0.024	0.005
Skid Steer Loaders	2027	50	75	0.154	0.129	1.753	3.243	0.005	0.047	0.043	528.655	0.021	0.004
Skid Steer Loaders	2027	75	100	2.084	1.751	14.484	5.886	0.005	0.981	0.903	528.023	0.021	0.004
Skid Steer Loaders	2027	100	175	0.135	0.114	1.015	2.911	0.005	0.040	0.036	528.073	0.021	0.004
Skid Steer Loaders	2027	175	300	0.118	0.100	1.040	0.989	0.005	0.029	0.027	528.177	0.021	0.004
Skid Steer Loaders	2027	300	600	0.208	0.175	2.096	1.006	0.005	0.093	0.085	528.537	0.021	0.004
Skid Steer Loaders	2027	600	750	0.208	0.175	2.096	1.006	0.005	0.093	0.085	528.537	0.021	0.004
Skid Steer Loaders	2027	750	999	0.098	0.082	2.313	0.968	0.005	0.031	0.028	528.537	0.021	0.004
Skid Steer Loaders	2028	0	25	1.023	0.846	6.469	3.493	0.011	0.244	0.224	848.214	0.034	0.007
Skid Steer Loaders	2028	25	50	0.366	0.308	3.198	3.577	0.005	0.069	0.063	588.561	0.024	0.005
Skid Steer Loaders	2028	50	75	0.150	0.126	1.712	3.245	0.005	0.043	0.039	528.614	0.021	0.004
Skid Steer Loaders	2028	75	100	2.093	1.759	14.524	5.904	0.005	0.987	0.908	528.023	0.021	0.004
Skid Steer Loaders	2028	100	175	0.135	0.114	0.963	2.921	0.005	0.040	0.037	528.158	0.021	0.004
Skid Steer Loaders	2028	175	300	0.122	0.102	1.062	0.993	0.005	0.030	0.027	528.080	0.021	0.004
Skid Steer Loaders	2028	300	600	0.211	0.177	2.100	1.009	0.005	0.093	0.086	528.537	0.021	0.004
Skid Steer Loaders	2028	600	750	0.211	0.177	2.100	1.009	0.005	0.093	0.086	528.537	0.021	0.004
Skid Steer Loaders	2028	750	999	0.102	0.086	2.321	0.973	0.005	0.032	0.029	528.537	0.021	0.004
Skid Steer Loaders	2029	0	25	1.023	0.846	6.467	3.493	0.011	0.243	0.223	848.219	0.034	0.007
Skid Steer Loaders	2029	25	50	0.361	0.304	3.179	3.558	0.005	0.067	0.062	588.387	0.024	0.005
Skid Steer Loaders	2029	50	75	0.148	0.124	1.682	3.245	0.005	0.041	0.038	529.013	0.021	0.004
Skid Steer Loaders	2029	75	100	0.298	0.250	3.168	3.513	0.005	0.065	0.060	524.772	0.021	0.004
Skid Steer Loaders	2029	100	175	0.137	0.115	0.971	2.931	0.005	0.040	0.037	528.339	0.021	0.004
Skid Steer Loaders	2029	175	300	0.126	0.106	1.085	0.999	0.005	0.030	0.028	528.224	0.021	0.004
Skid Steer Loaders	2029	300	600	0.214	0.180	2.104	1.012	0.005	0.094	0.086	528.537	0.021	0.004
Skid Steer Loaders	2029	600	750	0.214	0.180	2.104	1.012	0.005	0.094	0.086	528.537	0.021	0.004
Skid Steer Loaders	2029	750	999	0.107	0.090	2.323	0.976	0.005	0.033	0.030	527.040	0.021	0.004
Skid Steer Loaders	2030	0	25	1.023	0.846	6.466	3.493	0.011	0.242	0.223	848.209	0.034	0.007
Skid Steer Loaders	2030	25	50	0.349	0.293	3.155	3.545	0.005	0.063	0.058	588.387	0.024	0.005
Skid Steer Loaders	2030	50	75	0.142	0.119	1.655	3.242	0.005	0.037	0.034	529.013	0.021	0.004
Skid Steer Loaders	2030	75	100	0.254	0.214	2.104	3.513	0.005	0.065	0.060	524.772	0.021	0.004
Skid Steer Loaders	2030	100	175	0.132	0.111	0.833	2.931	0.005	0.036	0.033	528.339	0.021	0.004
Skid Steer Loaders	2030	175	300	0.121	0.102	0.875	0.999	0.005	0.030	0.028	528.224	0.021	0.004
Skid Steer Loaders	2030	300	600	0.214	0.180	2.104	1.012	0.005	0.094	0.086	528.537	0.021	0.004
Skid Steer Loaders	2030	600	750	0.214	0.180	2.104	1.012	0.005	0.094	0.086	528.537	0.021	0.004
Skid Steer Loaders	2030	750	999	0.107	0.090	2.323	0.976	0.005	0.033	0.030	527.040	0.021	0.004
Skid Steer Loaders	2031	0	25	1.023	0.846	6.466	3.493	0.011	0.242	0.222	848.232	0.034	0.007
Skid Steer Loaders	2031	25	50	0.329	0.277	3.124	3.520	0.005	0.057	0.053	588.388	0.024	0.005
Skid Steer Loaders	2031	50	75	0.138	0.116	1.618	3.241	0.005	0.034	0.031	529.022	0.021	0.004
Skid Steer Loaders	2031	75	100	0.241	0.203	2.009	3.481	0.005	0.062	0.057	524.772	0.021	0.004
Skid Steer Loaders	2031	100	175	0.130	0.109	0.742	2.931	0.005	0.035	0.032	528.339	0.021	0.004
Skid Steer Loaders	2031	175	300	0.119	0.100	0.841	0.999	0.005	0.030	0.028	528.224	0.021	0.004
Skid Steer Loaders	2031	300	600	0.214	0.180	2.104	1.012	0.005	0.094	0.086	528.537	0.021	0.004
Skid Steer Loaders	2031	600	750	0.214	0.180	2.104	1.012	0.005	0.094	0.086	528.537	0.021	0.004
Skid Steer Loaders	2031	750	999	0.090	0.076	2.323	0.976	0.005	0.020	0.018	527.040	0.021	0.004
Skid Steer Loaders	2032	0	25	1.023	0.846	6.466	3.493	0.011	0.242	0.222	848.214	0.034	0.007
Skid Steer Loaders	2032	25	50	0.318	0.267	3.104	3.509	0.005	0.053	0.049	588.387	0.024	0.005
Skid Steer Loaders	2032	50	75	0.134	0.113	1.582	3.239	0.005	0.032	0.029	529.013	0.021	0.004
Skid Steer Loaders	2032	75	100	0.241	0.203	2.009	3.481	0.005	0.062	0.057	524.772	0.021	0.004

Unmitigated EFs from Caleemod 2022 (based on OFFROAD 2017) Appx G, Table G-11

Equipment	Year	Low HP	High HP	TOG	ROG	NOX	CO	SO2	PM10	PM2.5	CO2	CH4	N2O
Skid Steer Loaders	2032	100	175	0.130	0.109	0.742	2.931	0.005	0.035	0.032	528.339	0.021	0.004
Skid Steer Loaders	2032	175	300	0.118	0.099	0.715	0.999	0.005	0.030	0.028	528.224	0.021	0.004
Skid Steer Loaders	2032	300	600	0.159	0.134	1.188	1.012	0.005	0.010	0.009	528.537	0.021	0.004
Skid Steer Loaders	2032	600	750	0.159	0.134	1.188	1.012	0.005	0.010	0.009	528.537	0.021	0.004
Skid Steer Loaders	2032	750	999	0.090	0.076	2.323	0.976	0.005	0.020	0.018	527.040	0.021	0.004
Skid Steer Loaders	2033	0	25	1.023	0.846	6.466	3.493	0.011	0.242	0.222	848.211	0.034	0.007
Skid Steer Loaders	2033	25	50	0.303	0.255	3.098	3.493	0.005	0.049	0.045	588.387	0.024	0.005
Skid Steer Loaders	2033	50	75	0.131	0.110	1.548	3.237	0.005	0.029	0.027	529.013	0.021	0.004
Skid Steer Loaders	2033	75	100	0.241	0.203	2.009	3.481	0.005	0.062	0.057	524.772	0.021	0.004
Skid Steer Loaders	2033	100	175	0.128	0.107	0.696	2.931	0.005	0.035	0.032	528.339	0.021	0.004
Skid Steer Loaders	2033	175	300	0.113	0.095	0.631	0.999	0.005	0.022	0.021	528.224	0.021	0.004
Skid Steer Loaders	2033	300	600	0.159	0.134	1.188	1.012	0.005	0.010	0.009	528.537	0.021	0.004
Skid Steer Loaders	2033	600	750	0.159	0.134	1.188	1.012	0.005	0.010	0.009	528.537	0.021	0.004
Skid Steer Loaders	2033	750	999	0.090	0.076	2.323	0.976	0.005	0.020	0.018	527.040	0.021	0.004
Skid Steer Loaders	2034	0	25	1.023	0.846	6.466	3.493	0.011	0.242	0.222	848.238	0.034	0.007
Skid Steer Loaders	2034	25	50	0.286	0.240	3.086	3.473	0.005	0.046	0.043	588.387	0.024	0.005
Skid Steer Loaders	2034	50	75	0.128	0.107	1.529	3.236	0.005	0.027	0.025	529.013	0.021	0.004
Skid Steer Loaders	2034	75	100	0.241	0.203	2.009	3.481	0.005	0.062	0.057	524.772	0.021	0.004
Skid Steer Loaders	2034	100	175	0.120	0.100	0.544	2.923	0.005	0.027	0.025	528.317	0.021	0.004
Skid Steer Loaders	2034	175	300	0.116	0.098	0.674	1.192	0.005	0.025	0.023	528.254	0.021	0.004
Skid Steer Loaders	2034	300	600	0.159	0.134	1.188	1.012	0.005	0.010	0.009	528.537	0.021	0.004
Skid Steer Loaders	2034	600	750	0.159	0.134	1.188	1.012	0.005	0.010	0.009	528.537	0.021	0.004
Skid Steer Loaders	2034	750	999	0.090	0.076	2.323	0.976	0.005	0.020	0.018	527.040	0.021	0.004
Skid Steer Loaders	2035	0	25	1.023	0.846	6.466	3.493	0.011	0.242	0.222	848.225	0.034	0.007
Skid Steer Loaders	2035	25	50	0.275	0.231	3.072	3.460	0.005	0.043	0.039	588.387	0.024	0.005
Skid Steer Loaders	2035	50	75	0.125	0.105	1.515	3.235	0.005	0.025	0.023	529.013	0.021	0.004
Skid Steer Loaders	2035	75	100	0.241	0.203	2.009	3.481	0.005	0.062	0.057	524.772	0.021	0.004
Skid Steer Loaders	2035	100	175	0.124	0.105	0.649	2.931	0.005	0.025	0.023	528.339	0.021	0.004
Skid Steer Loaders	2035	175	300	0.109	0.091	0.561	0.999	0.005	0.016	0.015	528.224	0.021	0.004
Skid Steer Loaders	2035	300	600	0.112	0.094	0.274	1.012	0.005	0.010	0.009	528.537	0.021	0.004
Skid Steer Loaders	2035	600	750	0.112	0.094	0.274	1.012	0.005	0.010	0.009	528.537	0.021	0.004
Skid Steer Loaders	2035	750	999	0.090	0.076	2.323	0.976	0.005	0.020	0.018	527.040	0.021	0.004
Surfacing Equipment	2025	25	50	0.275	0.231	3.526	3.488	0.005	0.080	0.074	591.326	0.024	0.005
Surfacing Equipment	2025	50	75	0.725	0.610	6.180	3.816	0.005	0.402	0.370	530.261	0.022	0.004
Surfacing Equipment	2025	75	100	0.161	0.135	1.904	3.266	0.005	0.058	0.054	532.453	0.022	0.004
Surfacing Equipment	2025	100	175	0.319	0.268	2.623	3.106	0.005	0.147	0.135	528.391	0.021	0.004
Surfacing Equipment	2025	175	300	0.198	0.167	2.031	1.295	0.005	0.069	0.063	528.396	0.021	0.004
Surfacing Equipment	2025	300	600	0.125	0.105	0.993	1.068	0.005	0.036	0.033	527.121	0.021	0.004
Surfacing Equipment	2025	600	750	0.108	0.091	0.810	1.000	0.005	0.033	0.031	527.646	0.021	0.004
Surfacing Equipment	2025	750	999	0.164	0.137	3.090	1.120	0.005	0.056	0.052	527.980	0.021	0.004
Surfacing Equipment	2026	25	50	0.275	0.231	3.465	3.499	0.005	0.072	0.066	589.707	0.024	0.005
Surfacing Equipment	2026	50	75	0.733	0.616	6.200	3.832	0.005	0.406	0.374	530.215	0.022	0.004
Surfacing Equipment	2026	75	100	0.162	0.136	1.888	3.274	0.005	0.057	0.052	532.222	0.022	0.004
Surfacing Equipment	2026	100	175	0.293	0.246	2.243	3.060	0.005	0.129	0.119	527.796	0.021	0.004
Surfacing Equipment	2026	175	300	0.195	0.164	1.933	1.303	0.005	0.069	0.063	528.804	0.021	0.004
Surfacing Equipment	2026	300	600	0.114	0.096	0.834	1.053	0.005	0.030	0.027	527.817	0.021	0.004
Surfacing Equipment	2026	600	750	0.102	0.086	0.691	0.997	0.005	0.028	0.026	526.986	0.021	0.004
Surfacing Equipment	2026	750	999	0.147	0.124	2.814	1.133	0.005	0.048	0.044	527.948	0.021	0.004
Surfacing Equipment	2027	25	50	0.227	0.191	3.333	3.434	0.005	0.053	0.049	587.566	0.024	0.005
Surfacing Equipment	2027	50	75	0.647	0.544	5.640	3.773	0.005	0.369	0.340	530.210	0.022	0.004
Surfacing Equipment	2027	75	100	0.157	0.132	1.788	3.266	0.005	0.045	0.042	531.453	0.022	0.004
Surfacing Equipment	2027	100	175	0.278	0.233	2.076	3.056	0.005	0.119	0.109	527.796	0.021	0.004
Surfacing Equipment	2027	175	300	0.190	0.160	1.817	1.297	0.005	0.066	0.061	528.438	0.021	0.004
Surfacing Equipment	2027	300	600	0.112	0.094	0.778	1.054	0.005	0.027	0.025	527.255	0.021	0.004
Surfacing Equipment	2027	600	750	0.098	0.082	0.608	0.997	0.005	0.024	0.022	527.275	0.021	0.004
Surfacing Equipment	2027	750	999	0.151	0.127	2.822	1.137	0.005	0.048	0.044	527.934	0.021	0.004
Surfacing Equipment	2028	0	25	0.266	0.224	2.978	3.806	0.005	0.013	0.012	588.235	0.024	0.005
Surfacing Equipment	2028	25	50	0.223	0.188	3.246	3.395	0.005	0.047	0.043	585.804	0.024	0.005
Surfacing Equipment	2028	50	75	0.683	0.574	5.996	3.824	0.005	0.382	0.352	531.981	0.022	0.004
Surfacing Equipment	2028	75	100	0.134	0.113	1.569	3.238	0.005	0.030	0.027	529.127	0.021	0.004
Surfacing Equipment	2028	100	175	0.292	0.245	2.122	3.072	0.005	0.127	0.117	526.715	0.021	0.004
Surfacing Equipment	2028	175	300	0.192	0.162	1.781	1.310	0.005	0.066	0.060	528.035	0.021	0.004
Surfacing Equipment	2028	300	600	0.108	0.091	0.699	1.057	0.005	0.025	0.023	527.315	0.021	0.004
Surfacing Equipment	2028	600	750	0.099	0.083	0.598	0.998	0.005	0.024	0.022	527.194	0.021	0.004
Surfacing Equipment	2028	750	999	0.154	0.129	2.830	1.142	0.005	0.048	0.045	527.949	0.021	0.004
Surfacing Equipment	2029	0	25	0.273	0.230	2.987	3.854	0.005	0.013	0.012	588.235	0.024	0.005

Unmitigated EFs from Caleemod 2022 (based on OFFROAD 2017) Appx G, Table G-11

Equipment	Year	Low HP	High HP	TOG	ROG	NOX	CO	SO2	PM10	PM2.5	CO2	CH4	N2O
Surfacing Equipment	2029	25	50	0.200	0.168	3.097	3.354	0.005	0.024	0.022	585.348	0.024	0.005
Surfacing Equipment	2029	50	75	0.720	0.605	6.109	3.853	0.005	0.397	0.366	529.791	0.021	0.004
Surfacing Equipment	2029	75	100	0.154	0.130	1.675	3.241	0.005	0.044	0.040	528.372	0.021	0.004
Surfacing Equipment	2029	100	175	0.248	0.209	1.876	3.057	0.005	0.096	0.088	527.048	0.021	0.004
Surfacing Equipment	2029	175	300	0.191	0.160	1.708	1.336	0.005	0.062	0.057	528.542	0.021	0.004
Surfacing Equipment	2029	300	600	0.106	0.089	0.651	1.057	0.005	0.023	0.022	527.284	0.021	0.004
Surfacing Equipment	2029	600	750	0.102	0.085	0.600	1.002	0.005	0.024	0.022	527.326	0.021	0.004
Surfacing Equipment	2029	750	999	0.150	0.126	2.829	1.141	0.005	0.045	0.042	527.936	0.021	0.004
Surfacing Equipment	2030	0	25	0.273	0.230	2.987	3.854	0.005	0.013	0.012	588.235	0.024	0.005
Surfacing Equipment	2030	25	50	0.200	0.168	3.097	3.354	0.005	0.024	0.022	585.348	0.024	0.005
Surfacing Equipment	2030	50	75	0.669	0.562	5.507	3.829	0.005	0.373	0.343	529.791	0.021	0.004
Surfacing Equipment	2030	75	100	0.154	0.130	1.675	3.241	0.005	0.044	0.040	528.372	0.021	0.004
Surfacing Equipment	2030	100	175	0.247	0.207	1.869	3.057	0.005	0.095	0.087	527.048	0.021	0.004
Surfacing Equipment	2030	175	300	0.188	0.158	1.644	1.336	0.005	0.061	0.056	528.542	0.021	0.004
Surfacing Equipment	2030	300	600	0.102	0.086	0.618	1.043	0.005	0.022	0.020	527.284	0.021	0.004
Surfacing Equipment	2030	600	750	0.091	0.077	0.557	0.956	0.005	0.019	0.018	527.326	0.021	0.004
Surfacing Equipment	2030	750	999	0.140	0.117	2.829	1.141	0.005	0.042	0.038	527.936	0.021	0.004
Surfacing Equipment	2031	0	25	0.273	0.230	2.987	3.854	0.005	0.013	0.012	588.235	0.024	0.005
Surfacing Equipment	2031	25	50	0.200	0.168	2.981	3.354	0.005	0.015	0.014	585.348	0.024	0.005
Surfacing Equipment	2031	50	75	0.656	0.551	5.288	3.823	0.005	0.369	0.339	529.791	0.021	0.004
Surfacing Equipment	2031	75	100	0.143	0.120	1.647	3.236	0.005	0.037	0.034	528.372	0.021	0.004
Surfacing Equipment	2031	100	175	0.244	0.205	1.778	3.057	0.005	0.094	0.087	527.048	0.021	0.004
Surfacing Equipment	2031	175	300	0.178	0.150	1.519	1.307	0.005	0.057	0.053	528.542	0.021	0.004
Surfacing Equipment	2031	300	600	0.097	0.082	0.561	1.030	0.005	0.020	0.018	527.284	0.021	0.004
Surfacing Equipment	2031	600	750	0.089	0.075	0.518	0.956	0.005	0.016	0.015	527.326	0.021	0.004
Surfacing Equipment	2031	750	999	0.140	0.117	2.829	1.141	0.005	0.042	0.038	527.936	0.021	0.004
Surfacing Equipment	2032	0	25	0.273	0.230	2.987	3.854	0.005	0.013	0.012	588.235	0.024	0.005
Surfacing Equipment	2032	25	50	0.200	0.168	2.912	3.354	0.005	0.014	0.013	585.348	0.024	0.005
Surfacing Equipment	2032	50	75	0.563	0.473	4.402	3.622	0.005	0.340	0.312	529.791	0.021	0.004
Surfacing Equipment	2032	75	100	0.139	0.116	1.634	3.234	0.005	0.034	0.031	528.372	0.021	0.004
Surfacing Equipment	2032	100	175	0.227	0.190	1.578	3.057	0.005	0.089	0.082	527.048	0.021	0.004
Surfacing Equipment	2032	175	300	0.176	0.148	1.429	1.307	0.005	0.055	0.051	528.542	0.021	0.004
Surfacing Equipment	2032	300	600	0.097	0.081	0.552	1.030	0.005	0.019	0.018	527.284	0.021	0.004
Surfacing Equipment	2032	600	750	0.089	0.075	0.518	0.956	0.005	0.016	0.015	527.326	0.021	0.004
Surfacing Equipment	2032	750	999	0.140	0.117	2.829	1.141	0.005	0.042	0.038	527.936	0.021	0.004
Surfacing Equipment	2033	0	25	0.273	0.230	2.987	3.854	0.005	0.013	0.012	588.235	0.024	0.005
Surfacing Equipment	2033	25	50	0.200	0.168	2.874	3.354	0.005	0.010	0.010	585.348	0.024	0.005
Surfacing Equipment	2033	50	75	0.554	0.465	4.209	3.618	0.005	0.336	0.309	529.791	0.021	0.004
Surfacing Equipment	2033	75	100	0.136	0.114	1.622	3.233	0.005	0.031	0.028	528.372	0.021	0.004
Surfacing Equipment	2033	100	175	0.221	0.186	1.549	3.057	0.005	0.083	0.076	527.048	0.021	0.004
Surfacing Equipment	2033	175	300	0.172	0.144	1.367	1.307	0.005	0.052	0.048	528.542	0.021	0.004
Surfacing Equipment	2033	300	600	0.097	0.081	0.551	1.030	0.005	0.019	0.018	527.284	0.021	0.004
Surfacing Equipment	2033	600	750	0.087	0.073	0.482	0.956	0.005	0.013	0.012	527.326	0.021	0.004
Surfacing Equipment	2033	750	999	0.140	0.117	2.843	1.141	0.005	0.044	0.041	527.936	0.021	0.004
Surfacing Equipment	2034	0	25	0.273	0.230	2.987	3.854	0.005	0.013	0.012	588.235	0.024	0.005
Surfacing Equipment	2034	25	50	0.200	0.168	2.874	3.354	0.005	0.010	0.010	585.348	0.024	0.005
Surfacing Equipment	2034	50	75	0.505	0.425	4.036	3.597	0.005	0.289	0.266	529.791	0.021	0.004
Surfacing Equipment	2034	75	100	0.136	0.114	1.622	3.233	0.005	0.030	0.028	528.372	0.021	0.004
Surfacing Equipment	2034	100	175	0.221	0.186	1.542	3.063	0.005	0.083	0.077	527.049	0.021	0.004
Surfacing Equipment	2034	175	300	0.164	0.138	1.292	1.302	0.005	0.048	0.044	528.523	0.021	0.004
Surfacing Equipment	2034	300	600	0.096	0.080	0.543	1.028	0.005	0.019	0.018	527.284	0.021	0.004
Surfacing Equipment	2034	600	750	0.085	0.071	0.442	0.956	0.005	0.013	0.012	527.326	0.021	0.004
Surfacing Equipment	2034	750	999	0.140	0.117	2.843	1.141	0.005	0.044	0.041	527.936	0.021	0.004
Surfacing Equipment	2035	0	25	0.273	0.230	2.987	3.854	0.005	0.013	0.012	588.235	0.024	0.005
Surfacing Equipment	2035	25	50	0.200	0.168	2.874	3.354	0.005	0.010	0.010	585.348	0.024	0.005
Surfacing Equipment	2035	50	75	0.489	0.411	3.987	3.589	0.005	0.277	0.255	529.791	0.021	0.004
Surfacing Equipment	2035	75	100	0.130	0.110	1.560	3.230	0.005	0.026	0.023	528.372	0.021	0.004
Surfacing Equipment	2035	100	175	0.218	0.183	1.511	3.057	0.005	0.081	0.075	527.048	0.021	0.004
Surfacing Equipment	2035	175	300	0.157	0.132	1.219	1.254	0.005	0.045	0.042	528.542	0.021	0.004
Surfacing Equipment	2035	300	600	0.095	0.080	0.515	1.028	0.005	0.019	0.017	527.284	0.021	0.004
Surfacing Equipment	2035	600	750	0.085	0.071	0.442	0.956	0.005	0.013	0.012	527.326	0.021	0.004
Surfacing Equipment	2035	750	999	0.140	0.117	2.843	1.141	0.005	0.044	0.041	527.936	0.021	0.004
Sweepers/Scrubbers	2025	0	25	0.970	0.802	6.368	4.137	0.012	0.242	0.223	849.457	0.034	0.007
Sweepers/Scrubbers	2025	25	50	0.740	0.622	3.851	4.762	0.005	0.191	0.176	586.859	0.024	0.005
Sweepers/Scrubbers	2025	50	75	1.067	0.897	6.798	4.347	0.005	0.597	0.549	525.363	0.021	0.004
Sweepers/Scrubbers	2025	75	100	0.283	0.238	2.376	3.570	0.005	0.112	0.103	527.853	0.021	0.004

Unmitigated EFs from Caleemod 2022 (based on OFFROAD 2017) Appx G, Table G-11

Equipment	Year	Low HP	High HP	TOG	ROG	NOX	CO	SO2	PM10	PM2.5	CO2	CH4	N2O
Sweepers/Scrubbers	2025	100	175	0.253	0.213	1.634	3.194	0.005	0.072	0.066	528.031	0.021	0.004
Sweepers/Scrubbers	2025	175	300	0.230	0.193	1.995	1.144	0.005	0.064	0.059	528.031	0.021	0.004
Sweepers/Scrubbers	2025	300	600	0.096	0.081	0.269	0.986	0.005	0.010	0.009	528.031	0.021	0.004
Sweepers/Scrubbers	2025	600	750	0.096	0.081	0.269	0.986	0.005	0.010	0.009	528.031	0.021	0.004
Sweepers/Scrubbers	2025	750	999	0.076	0.064	2.293	0.956	0.005	0.019	0.017	528.031	0.021	0.004
Sweepers/Scrubbers	2026	0	25	0.970	0.802	6.367	4.136	0.012	0.242	0.223	849.238	0.034	0.007
Sweepers/Scrubbers	2026	25	50	0.696	0.584	3.759	4.731	0.005	0.171	0.157	586.659	0.024	0.005
Sweepers/Scrubbers	2026	50	75	0.977	0.821	6.497	4.337	0.005	0.514	0.473	525.912	0.021	0.004
Sweepers/Scrubbers	2026	75	100	0.279	0.235	2.258	3.566	0.005	0.104	0.096	527.890	0.021	0.004
Sweepers/Scrubbers	2026	100	175	0.262	0.220	1.639	3.235	0.005	0.072	0.067	528.031	0.021	0.004
Sweepers/Scrubbers	2026	175	300	0.222	0.186	1.817	1.145	0.005	0.059	0.054	528.031	0.021	0.004
Sweepers/Scrubbers	2026	300	600	0.104	0.087	0.271	0.998	0.005	0.010	0.009	528.031	0.021	0.004
Sweepers/Scrubbers	2026	600	750	0.104	0.087	0.271	0.998	0.005	0.010	0.009	528.031	0.021	0.004
Sweepers/Scrubbers	2026	750	999	0.084	0.070	2.312	0.968	0.005	0.019	0.018	528.031	0.021	0.004
Sweepers/Scrubbers	2027	0	25	0.970	0.802	6.365	4.135	0.012	0.242	0.223	849.042	0.034	0.007
Sweepers/Scrubbers	2027	25	50	0.643	0.541	3.671	4.690	0.005	0.149	0.137	586.632	0.024	0.005
Sweepers/Scrubbers	2027	50	75	0.724	0.608	4.900	3.971	0.005	0.363	0.334	524.353	0.021	0.004
Sweepers/Scrubbers	2027	75	100	0.269	0.226	2.174	3.589	0.005	0.091	0.083	527.969	0.021	0.004
Sweepers/Scrubbers	2027	100	175	0.230	0.193	1.273	3.248	0.005	0.053	0.049	528.031	0.021	0.004
Sweepers/Scrubbers	2027	175	300	0.228	0.191	1.819	1.156	0.005	0.059	0.055	528.031	0.021	0.004
Sweepers/Scrubbers	2027	300	600	0.112	0.094	0.274	1.010	0.005	0.010	0.009	528.031	0.021	0.004
Sweepers/Scrubbers	2027	600	750	0.112	0.094	0.274	1.010	0.005	0.010	0.009	528.031	0.021	0.004
Sweepers/Scrubbers	2027	750	999	0.092	0.077	2.331	0.980	0.005	0.020	0.018	528.031	0.021	0.004
Sweepers/Scrubbers	2028	0	25	0.970	0.802	6.367	4.136	0.012	0.242	0.223	849.318	0.034	0.007
Sweepers/Scrubbers	2028	25	50	0.616	0.517	3.613	4.688	0.005	0.133	0.123	586.827	0.024	0.005
Sweepers/Scrubbers	2028	50	75	0.854	0.718	5.698	4.260	0.005	0.438	0.403	524.554	0.021	0.004
Sweepers/Scrubbers	2028	75	100	0.243	0.205	1.963	3.570	0.005	0.069	0.064	527.841	0.021	0.004
Sweepers/Scrubbers	2028	100	175	0.232	0.195	1.234	3.270	0.005	0.053	0.049	528.031	0.021	0.004
Sweepers/Scrubbers	2028	175	300	0.185	0.156	1.105	1.138	0.005	0.042	0.038	528.031	0.021	0.004
Sweepers/Scrubbers	2028	300	600	0.120	0.101	0.276	1.022	0.005	0.010	0.009	528.031	0.021	0.004
Sweepers/Scrubbers	2028	600	750	0.120	0.101	0.276	1.022	0.005	0.010	0.009	528.031	0.021	0.004
Sweepers/Scrubbers	2028	750	999	0.100	0.084	2.349	0.992	0.005	0.020	0.019	528.031	0.021	0.004
Sweepers/Scrubbers	2029	0	25	0.963	0.796	6.355	4.171	0.012	0.242	0.223	844.397	0.034	0.007
Sweepers/Scrubbers	2029	25	50	0.601	0.505	3.565	4.716	0.005	0.122	0.113	586.869	0.024	0.005
Sweepers/Scrubbers	2029	50	75	0.875	0.735	5.828	4.311	0.005	0.447	0.411	525.477	0.021	0.004
Sweepers/Scrubbers	2029	75	100	0.245	0.206	1.931	3.588	0.005	0.066	0.061	527.971	0.021	0.004
Sweepers/Scrubbers	2029	100	175	0.231	0.194	1.236	3.263	0.005	0.053	0.049	528.031	0.021	0.004
Sweepers/Scrubbers	2029	175	300	0.171	0.144	0.763	1.139	0.005	0.033	0.030	528.031	0.021	0.004
Sweepers/Scrubbers	2029	300	600	0.128	0.107	0.278	1.034	0.005	0.011	0.010	528.031	0.021	0.004
Sweepers/Scrubbers	2029	600	750	0.128	0.107	0.278	1.034	0.005	0.011	0.010	528.031	0.021	0.004
Sweepers/Scrubbers	2029	750	999	0.108	0.090	2.368	1.004	0.005	0.021	0.019	528.031	0.021	0.004
Sweepers/Scrubbers	2030	0	25	0.963	0.796	6.311	4.171	0.012	0.238	0.219	844.321	0.034	0.007
Sweepers/Scrubbers	2030	25	50	0.550	0.462	3.553	4.664	0.005	0.111	0.102	586.869	0.024	0.005
Sweepers/Scrubbers	2030	50	75	0.781	0.656	5.174	4.208	0.005	0.390	0.359	525.477	0.021	0.004
Sweepers/Scrubbers	2030	75	100	0.242	0.203	1.859	3.587	0.005	0.064	0.059	527.971	0.021	0.004
Sweepers/Scrubbers	2030	100	175	0.228	0.191	1.159	3.263	0.005	0.054	0.050	528.031	0.021	0.004
Sweepers/Scrubbers	2030	175	300	0.171	0.144	0.683	1.139	0.005	0.033	0.030	528.031	0.021	0.004
Sweepers/Scrubbers	2030	300	600	0.128	0.107	0.278	1.034	0.005	0.011	0.010	528.031	0.021	0.004
Sweepers/Scrubbers	2030	600	750	0.128	0.107	0.278	1.034	0.005	0.011	0.010	528.031	0.021	0.004
Sweepers/Scrubbers	2030	750	999	0.108	0.090	2.368	1.004	0.005	0.021	0.019	528.031	0.021	0.004
Sweepers/Scrubbers	2031	0	25	0.963	0.796	6.311	4.172	0.012	0.238	0.219	844.309	0.034	0.007
Sweepers/Scrubbers	2031	25	50	0.520	0.437	3.532	4.634	0.005	0.100	0.092	586.869	0.024	0.005
Sweepers/Scrubbers	2031	50	75	0.743	0.625	4.832	4.199	0.005	0.380	0.349	525.477	0.021	0.004
Sweepers/Scrubbers	2031	75	100	0.235	0.197	1.811	3.584	0.005	0.056	0.052	527.971	0.021	0.004
Sweepers/Scrubbers	2031	100	175	0.216	0.182	1.016	3.263	0.005	0.050	0.046	528.031	0.021	0.004
Sweepers/Scrubbers	2031	175	300	0.171	0.144	0.683	1.139	0.005	0.033	0.030	528.031	0.021	0.004
Sweepers/Scrubbers	2031	300	600	0.128	0.107	0.278	1.034	0.005	0.011	0.010	528.031	0.021	0.004
Sweepers/Scrubbers	2031	600	750	0.128	0.107	0.278	1.034	0.005	0.011	0.010	528.031	0.021	0.004
Sweepers/Scrubbers	2031	750	999	0.108	0.090	2.368	1.004	0.005	0.021	0.019	528.031	0.021	0.004
Sweepers/Scrubbers	2032	0	25	0.963	0.796	6.311	4.172	0.012	0.238	0.219	844.292	0.034	0.007
Sweepers/Scrubbers	2032	25	50	0.486	0.408	3.511	4.600	0.005	0.086	0.079	586.869	0.024	0.005
Sweepers/Scrubbers	2032	50	75	0.729	0.613	4.664	4.176	0.005	0.370	0.340	525.477	0.021	0.004
Sweepers/Scrubbers	2032	75	100	0.230	0.193	1.789	3.582	0.005	0.053	0.048	527.971	0.021	0.004
Sweepers/Scrubbers	2032	100	175	0.205	0.173	0.877	3.250	0.005	0.049	0.045	528.031	0.021	0.004
Sweepers/Scrubbers	2032	175	300	0.170	0.142	0.683	1.137	0.005	0.033	0.030	528.031	0.021	0.004
Sweepers/Scrubbers	2032	300	600	0.128	0.107	0.278	1.034	0.005	0.011	0.010	528.031	0.021	0.004

Unmitigated EFs from Caleemod 2022 (based on OFFROAD 2017) Appx G, Table G-11

Equipment	Year	Low HP	High HP	TOG	ROG	NOX	CO	SO2	PM10	PM2.5	CO2	CH4	N2O
Sweepers/Scrubbers	2032	600	750	0.128	0.107	0.278	1.034	0.005	0.011	0.010	528.031	0.021	0.004
Sweepers/Scrubbers	2032	750	999	0.108	0.090	2.368	1.004	0.005	0.021	0.019	528.031	0.021	0.004
Sweepers/Scrubbers	2033	0	25	0.963	0.796	6.312	4.173	0.012	0.238	0.219	844.471	0.034	0.007
Sweepers/Scrubbers	2033	25	50	0.460	0.387	3.492	4.575	0.005	0.075	0.069	586.869	0.024	0.005
Sweepers/Scrubbers	2033	50	75	0.676	0.568	4.138	4.136	0.005	0.337	0.310	525.477	0.021	0.004
Sweepers/Scrubbers	2033	75	100	0.228	0.191	1.779	3.581	0.005	0.048	0.044	527.971	0.021	0.004
Sweepers/Scrubbers	2033	100	175	0.186	0.156	0.703	3.255	0.005	0.030	0.028	528.031	0.021	0.004
Sweepers/Scrubbers	2033	175	300	0.191	0.160	0.863	1.272	0.005	0.043	0.040	528.031	0.021	0.004
Sweepers/Scrubbers	2033	300	600	0.128	0.107	0.278	1.034	0.005	0.011	0.010	528.031	0.021	0.004
Sweepers/Scrubbers	2033	600	750	0.128	0.107	0.278	1.034	0.005	0.011	0.010	528.031	0.021	0.004
Sweepers/Scrubbers	2033	750	999	0.108	0.090	2.368	1.004	0.005	0.021	0.019	528.031	0.021	0.004
Sweepers/Scrubbers	2034	0	25	0.970	0.802	6.369	4.137	0.012	0.242	0.223	849.482	0.034	0.007
Sweepers/Scrubbers	2034	25	50	0.435	0.365	3.461	4.549	0.005	0.067	0.062	586.870	0.024	0.005
Sweepers/Scrubbers	2034	50	75	0.612	0.514	3.925	4.096	0.005	0.299	0.275	525.477	0.021	0.004
Sweepers/Scrubbers	2034	75	100	0.224	0.188	1.740	3.580	0.005	0.043	0.040	527.971	0.021	0.004
Sweepers/Scrubbers	2034	100	175	0.200	0.168	0.818	3.250	0.005	0.041	0.038	528.031	0.021	0.004
Sweepers/Scrubbers	2034	175	300	0.159	0.134	0.572	1.137	0.005	0.021	0.019	528.031	0.021	0.004
Sweepers/Scrubbers	2034	300	600	0.128	0.107	0.278	1.034	0.005	0.011	0.010	528.031	0.021	0.004
Sweepers/Scrubbers	2034	600	750	0.128	0.107	0.278	1.034	0.005	0.011	0.010	528.031	0.021	0.004
Sweepers/Scrubbers	2034	750	999	0.108	0.090	2.368	1.004	0.005	0.021	0.019	528.031	0.021	0.004
Sweepers/Scrubbers	2035	0	25	0.963	0.796	6.314	4.175	0.012	0.238	0.219	844.700	0.034	0.007
Sweepers/Scrubbers	2035	25	50	0.421	0.354	3.411	4.530	0.005	0.060	0.055	586.869	0.024	0.005
Sweepers/Scrubbers	2035	50	75	0.560	0.471	3.774	4.064	0.005	0.268	0.246	525.477	0.021	0.004
Sweepers/Scrubbers	2035	75	100	0.222	0.187	1.706	3.580	0.005	0.040	0.037	527.971	0.021	0.004
Sweepers/Scrubbers	2035	100	175	0.192	0.162	0.775	3.250	0.005	0.037	0.034	528.031	0.021	0.004
Sweepers/Scrubbers	2035	175	300	0.154	0.130	0.524	1.109	0.005	0.018	0.016	528.031	0.021	0.004
Sweepers/Scrubbers	2035	300	600	0.128	0.107	0.278	1.034	0.005	0.011	0.010	528.031	0.021	0.004
Sweepers/Scrubbers	2035	600	750	0.128	0.107	0.278	1.034	0.005	0.011	0.010	528.031	0.021	0.004
Sweepers/Scrubbers	2035	750	999	0.108	0.090	2.368	1.004	0.005	0.021	0.019	528.031	0.021	0.004
Tractors/Loaders/Backh	2025	0	25	1.023	0.846	6.467	3.493	0.011	0.242	0.222	848.305	0.034	0.007
Tractors/Loaders/Backh	2025	25	50	0.661	0.556	3.699	4.606	0.005	0.146	0.135	580.494	0.024	0.005
Tractors/Loaders/Backh	2025	50	75	1.916	1.610	12.621	5.357	0.005	1.018	0.937	527.224	0.021	0.004
Tractors/Loaders/Backh	2025	75	100	0.233	0.196	2.010	3.482	0.005	0.077	0.071	529.863	0.021	0.004
Tractors/Loaders/Backh	2025	100	175	0.193	0.162	1.183	3.089	0.005	0.059	0.054	525.997	0.021	0.004
Tractors/Loaders/Backh	2025	175	300	0.194	0.163	1.399	1.221	0.005	0.053	0.049	526.844	0.021	0.004
Tractors/Loaders/Backh	2025	300	600	0.170	0.143	0.989	1.167	0.005	0.038	0.035	525.863	0.021	0.004
Tractors/Loaders/Backh	2025	600	750	0.173	0.146	1.120	1.660	0.005	0.045	0.042	503.925	0.020	0.004
Tractors/Loaders/Backh	2025	750	999	0.189	0.159	2.998	1.032	0.005	0.052	0.048	528.147	0.021	0.004
Tractors/Loaders/Backh	2026	0	25	1.023	0.846	6.467	3.493	0.011	0.242	0.222	848.340	0.034	0.007
Tractors/Loaders/Backh	2026	25	50	0.647	0.544	3.632	4.605	0.005	0.136	0.125	579.681	0.024	0.005
Tractors/Loaders/Backh	2026	50	75	1.845	1.551	12.132	5.190	0.005	0.999	0.919	527.604	0.021	0.004
Tractors/Loaders/Backh	2026	75	100	0.219	0.184	1.885	3.481	0.005	0.063	0.058	529.707	0.021	0.004
Tractors/Loaders/Backh	2026	100	175	0.185	0.156	1.074	3.098	0.005	0.053	0.048	526.226	0.021	0.004
Tractors/Loaders/Backh	2026	175	300	0.189	0.159	1.276	1.220	0.005	0.050	0.046	527.587	0.021	0.004
Tractors/Loaders/Backh	2026	300	600	0.165	0.139	0.876	1.171	0.005	0.034	0.031	526.330	0.021	0.004
Tractors/Loaders/Backh	2026	600	750	0.204	0.172	1.319	1.855	0.005	0.054	0.050	515.505	0.021	0.004
Tractors/Loaders/Backh	2026	750	999	0.162	0.136	2.737	1.018	0.005	0.042	0.038	527.971	0.021	0.004
Tractors/Loaders/Backh	2027	0	25	1.023	0.846	6.467	3.493	0.011	0.242	0.222	848.366	0.034	0.007
Tractors/Loaders/Backh	2027	25	50	0.624	0.525	3.558	4.589	0.005	0.122	0.113	579.496	0.024	0.005
Tractors/Loaders/Backh	2027	50	75	1.852	1.556	12.173	5.206	0.005	1.002	0.922	528.299	0.021	0.004
Tractors/Loaders/Backh	2027	75	100	0.211	0.177	1.807	3.487	0.005	0.054	0.050	529.618	0.021	0.004
Tractors/Loaders/Backh	2027	100	175	0.179	0.150	0.974	3.106	0.005	0.047	0.044	525.934	0.021	0.004
Tractors/Loaders/Backh	2027	175	300	0.185	0.156	1.181	1.195	0.005	0.047	0.043	527.267	0.021	0.004
Tractors/Loaders/Backh	2027	300	600	0.158	0.133	0.776	1.180	0.005	0.031	0.028	527.997	0.021	0.004
Tractors/Loaders/Backh	2027	600	750	0.212	0.178	1.368	1.910	0.005	0.056	0.052	523.186	0.021	0.004
Tractors/Loaders/Backh	2027	750	999	0.143	0.120	2.632	1.009	0.005	0.036	0.033	527.875	0.021	0.004
Tractors/Loaders/Backh	2028	0	25	1.023	0.846	6.467	3.493	0.011	0.242	0.222	848.255	0.034	0.007
Tractors/Loaders/Backh	2028	25	50	0.610	0.513	3.521	4.605	0.005	0.114	0.105	579.741	0.024	0.005
Tractors/Loaders/Backh	2028	50	75	1.858	1.561	12.217	5.221	0.005	1.004	0.923	528.280	0.021	0.004
Tractors/Loaders/Backh	2028	75	100	0.206	0.173	1.749	3.496	0.005	0.048	0.044	529.565	0.021	0.004
Tractors/Loaders/Backh	2028	100	175	0.175	0.147	0.899	3.113	0.005	0.044	0.041	525.709	0.021	0.004
Tractors/Loaders/Backh	2028	175	300	0.176	0.148	1.032	1.185	0.005	0.042	0.039	527.170	0.021	0.004
Tractors/Loaders/Backh	2028	300	600	0.156	0.131	0.721	1.181	0.005	0.029	0.026	528.124	0.021	0.004
Tractors/Loaders/Backh	2028	600	750	0.252	0.212	1.667	1.810	0.005	0.077	0.071	525.024	0.021	0.004
Tractors/Loaders/Backh	2028	750	999	0.132	0.111	2.536	1.007	0.005	0.031	0.029	527.872	0.021	0.004
Tractors/Loaders/Backh	2029	0	25	1.023	0.846	6.467	3.493	0.011	0.242	0.222	848.289	0.034	0.007

Unmitigated EFs from Caleemod 2022 (based on OFFROAD 2017) Appx G, Table G-11

Equipment	Year	Low HP	High HP	TOG	ROG	NOX	CO	SO2	PM10	PM2.5	CO2	CH4	N2O
Tractors/Loaders/Backh	2029	25	50	0.602	0.506	3.488	4.616	0.005	0.107	0.098	579.853	0.024	0.005
Tractors/Loaders/Backh	2029	50	75	1.860	1.563	12.231	5.227	0.005	1.005	0.924	528.607	0.021	0.004
Tractors/Loaders/Backh	2029	75	100	0.203	0.171	1.707	3.501	0.005	0.044	0.040	529.264	0.021	0.004
Tractors/Loaders/Backh	2029	100	175	0.172	0.145	0.847	3.122	0.005	0.042	0.039	525.868	0.021	0.004
Tractors/Loaders/Backh	2029	175	300	0.182	0.153	1.025	1.212	0.005	0.043	0.039	527.288	0.021	0.004
Tractors/Loaders/Backh	2029	300	600	0.149	0.126	0.634	1.159	0.005	0.025	0.023	529.211	0.021	0.004
Tractors/Loaders/Backh	2029	600	750	0.247	0.208	1.578	1.897	0.005	0.072	0.066	524.885	0.021	0.004
Tractors/Loaders/Backh	2029	750	999	0.125	0.105	2.472	1.006	0.005	0.027	0.025	527.888	0.021	0.004
Tractors/Loaders/Backh	2030	0	25	1.023	0.846	6.467	3.493	0.011	0.242	0.222	848.359	0.034	0.007
Tractors/Loaders/Backh	2030	25	50	0.580	0.487	3.467	4.590	0.005	0.100	0.092	579.853	0.024	0.005
Tractors/Loaders/Backh	2030	50	75	1.811	1.522	11.890	5.110	0.005	0.991	0.912	528.607	0.021	0.004
Tractors/Loaders/Backh	2030	75	100	0.198	0.166	1.676	3.499	0.005	0.040	0.037	529.264	0.021	0.004
Tractors/Loaders/Backh	2030	100	175	0.168	0.141	0.800	3.119	0.005	0.040	0.037	525.868	0.021	0.004
Tractors/Loaders/Backh	2030	175	300	0.177	0.149	0.961	1.207	0.005	0.040	0.037	527.288	0.021	0.004
Tractors/Loaders/Backh	2030	300	600	0.147	0.124	0.583	1.155	0.005	0.024	0.022	529.211	0.021	0.004
Tractors/Loaders/Backh	2030	600	750	0.245	0.206	1.547	1.897	0.005	0.072	0.066	524.885	0.021	0.004
Tractors/Loaders/Backh	2030	750	999	0.122	0.103	2.461	1.006	0.005	0.027	0.025	527.888	0.021	0.004
Tractors/Loaders/Backh	2031	0	25	1.023	0.846	6.467	3.493	0.011	0.242	0.222	848.355	0.034	0.007
Tractors/Loaders/Backh	2031	25	50	0.563	0.473	3.440	4.571	0.005	0.092	0.085	579.853	0.024	0.005
Tractors/Loaders/Backh	2031	50	75	1.811	1.522	11.890	5.110	0.005	0.991	0.912	528.607	0.021	0.004
Tractors/Loaders/Backh	2031	75	100	0.193	0.162	1.637	3.497	0.005	0.037	0.034	529.264	0.021	0.004
Tractors/Loaders/Backh	2031	100	175	0.164	0.138	0.752	3.117	0.005	0.038	0.035	525.868	0.021	0.004
Tractors/Loaders/Backh	2031	175	300	0.175	0.147	0.898	1.204	0.005	0.038	0.035	527.288	0.021	0.004
Tractors/Loaders/Backh	2031	300	600	0.147	0.123	0.571	1.154	0.005	0.024	0.022	529.211	0.021	0.004
Tractors/Loaders/Backh	2031	600	750	0.245	0.206	1.547	1.897	0.005	0.072	0.066	524.885	0.021	0.004
Tractors/Loaders/Backh	2031	750	999	0.120	0.101	2.461	1.006	0.005	0.026	0.024	527.888	0.021	0.004
Tractors/Loaders/Backh	2032	0	25	1.023	0.846	6.467	3.493	0.011	0.242	0.222	848.301	0.034	0.007
Tractors/Loaders/Backh	2032	25	50	0.548	0.461	3.403	4.554	0.005	0.084	0.078	579.853	0.024	0.005
Tractors/Loaders/Backh	2032	50	75	1.758	1.478	11.259	4.985	0.005	0.990	0.911	528.607	0.021	0.004
Tractors/Loaders/Backh	2032	75	100	0.190	0.160	1.610	3.495	0.005	0.034	0.032	529.264	0.021	0.004
Tractors/Loaders/Backh	2032	100	175	0.161	0.136	0.720	3.115	0.005	0.036	0.033	525.867	0.021	0.004
Tractors/Loaders/Backh	2032	175	300	0.172	0.144	0.867	1.197	0.005	0.036	0.033	527.288	0.021	0.004
Tractors/Loaders/Backh	2032	300	600	0.145	0.122	0.548	1.153	0.005	0.023	0.021	529.211	0.021	0.004
Tractors/Loaders/Backh	2032	600	750	0.245	0.206	1.547	1.897	0.005	0.072	0.066	524.885	0.021	0.004
Tractors/Loaders/Backh	2032	750	999	0.118	0.099	2.450	1.006	0.005	0.026	0.024	527.888	0.021	0.004
Tractors/Loaders/Backh	2033	0	25	1.023	0.846	6.468	3.493	0.011	0.242	0.222	848.388	0.034	0.007
Tractors/Loaders/Backh	2033	25	50	0.532	0.447	3.382	4.535	0.005	0.079	0.073	579.853	0.024	0.005
Tractors/Loaders/Backh	2033	50	75	1.735	1.458	10.920	4.929	0.005	0.992	0.913	528.607	0.021	0.004
Tractors/Loaders/Backh	2033	75	100	0.187	0.157	1.585	3.494	0.005	0.031	0.029	529.264	0.021	0.004
Tractors/Loaders/Backh	2033	100	175	0.159	0.133	0.686	3.112	0.005	0.033	0.030	525.868	0.021	0.004
Tractors/Loaders/Backh	2033	175	300	0.168	0.141	0.822	1.187	0.005	0.034	0.031	527.288	0.021	0.004
Tractors/Loaders/Backh	2033	300	600	0.144	0.121	0.530	1.151	0.005	0.022	0.020	529.211	0.021	0.004
Tractors/Loaders/Backh	2033	600	750	0.230	0.193	1.378	1.897	0.005	0.054	0.050	524.885	0.021	0.004
Tractors/Loaders/Backh	2033	750	999	0.118	0.099	2.372	1.006	0.005	0.023	0.021	527.888	0.021	0.004
Tractors/Loaders/Backh	2034	0	25	1.024	0.846	6.468	3.493	0.011	0.242	0.222	848.412	0.034	0.007
Tractors/Loaders/Backh	2034	25	50	0.519	0.436	3.353	4.521	0.005	0.074	0.068	579.853	0.024	0.005
Tractors/Loaders/Backh	2034	50	75	1.716	1.442	10.670	4.882	0.005	0.992	0.913	528.607	0.021	0.004
Tractors/Loaders/Backh	2034	75	100	0.185	0.155	1.567	3.493	0.005	0.029	0.027	529.264	0.021	0.004
Tractors/Loaders/Backh	2034	100	175	0.156	0.131	0.658	3.112	0.005	0.031	0.028	525.868	0.021	0.004
Tractors/Loaders/Backh	2034	175	300	0.165	0.139	0.778	1.183	0.005	0.032	0.029	527.288	0.021	0.004
Tractors/Loaders/Backh	2034	300	600	0.142	0.119	0.512	1.149	0.005	0.020	0.019	529.211	0.021	0.004
Tractors/Loaders/Backh	2034	600	750	0.225	0.189	1.358	1.875	0.005	0.052	0.048	524.885	0.021	0.004
Tractors/Loaders/Backh	2034	750	999	0.118	0.099	2.372	1.006	0.005	0.023	0.021	527.888	0.021	0.004
Tractors/Loaders/Backh	2035	0	25	1.023	0.846	6.466	3.493	0.011	0.242	0.222	848.241	0.034	0.007
Tractors/Loaders/Backh	2035	25	50	0.507	0.426	3.324	4.508	0.005	0.070	0.064	579.853	0.024	0.005
Tractors/Loaders/Backh	2035	50	75	1.704	1.432	10.483	4.855	0.005	0.995	0.915	528.607	0.021	0.004
Tractors/Loaders/Backh	2035	75	100	0.182	0.153	1.551	3.492	0.005	0.026	0.024	529.264	0.021	0.004
Tractors/Loaders/Backh	2035	100	175	0.153	0.129	0.633	3.110	0.005	0.029	0.027	525.867	0.021	0.004
Tractors/Loaders/Backh	2035	175	300	0.162	0.136	0.730	1.176	0.005	0.030	0.027	527.285	0.021	0.004
Tractors/Loaders/Backh	2035	300	600	0.140	0.118	0.487	1.136	0.005	0.019	0.017	529.212	0.021	0.004
Tractors/Loaders/Backh	2035	600	750	0.225	0.189	1.358	1.875	0.005	0.052	0.048	524.885	0.021	0.004
Tractors/Loaders/Backh	2035	750	999	0.118	0.099	2.372	1.006	0.005	0.023	0.021	527.888	0.021	0.004
Trenchers	2025	0	25	1.017	0.841	6.416	3.827	0.011	0.242	0.222	848.919	0.034	0.007
Trenchers	2025	25	50	0.643	0.540	3.646	4.108	0.005	0.162	0.149	587.948	0.024	0.005
Trenchers	2025	50	75	1.150	0.966	7.674	4.445	0.005	0.585	0.538	522.319	0.021	0.004
Trenchers	2025	75	100	0.461	0.387	3.830	3.626	0.005	0.240	0.221	530.152	0.022	0.004

Unmitigated EFs from Caleemod 2022 (based on OFFROAD 2017) Appx G, Table G-11

Equipment	Year	Low HP	High HP	TOG	ROG	NOX	CO	SO2	PM10	PM2.5	CO2	CH4	N2O
Trenchers	2025	100	175	0.486	0.408	3.825	3.401	0.005	0.228	0.210	527.186	0.021	0.004
Trenchers	2025	175	300	0.348	0.292	3.149	1.548	0.005	0.137	0.126	529.781	0.021	0.004
Trenchers	2025	300	600	0.208	0.175	1.605	1.625	0.005	0.068	0.062	529.637	0.021	0.004
Trenchers	2025	600	750	0.072	0.060	0.262	0.950	0.005	0.009	0.008	527.929	0.021	0.004
Trenchers	2025	750	999	1.397	1.174	13.392	14.184	0.005	0.624	0.574	528.023	0.021	0.004
Trenchers	2026	0	25	1.018	0.841	6.419	3.828	0.011	0.242	0.223	849.308	0.034	0.007
Trenchers	2026	25	50	0.602	0.506	3.536	4.047	0.005	0.141	0.130	588.094	0.024	0.005
Trenchers	2026	50	75	1.213	1.019	8.069	4.576	0.005	0.607	0.558	524.655	0.021	0.004
Trenchers	2026	75	100	0.450	0.378	3.728	3.617	0.005	0.232	0.213	529.355	0.021	0.004
Trenchers	2026	100	175	0.423	0.355	3.526	3.358	0.005	0.183	0.168	526.909	0.021	0.004
Trenchers	2026	175	300	0.327	0.274	2.814	1.525	0.005	0.127	0.117	527.799	0.021	0.004
Trenchers	2026	300	600	0.207	0.174	1.602	1.633	0.005	0.068	0.063	529.258	0.021	0.004
Trenchers	2026	600	750	0.076	0.064	0.263	0.955	0.005	0.009	0.008	527.846	0.021	0.004
Trenchers	2026	750	999	1.397	1.174	13.392	14.184	0.005	0.624	0.574	528.023	0.021	0.004
Trenchers	2027	0	25	1.017	0.841	6.416	3.827	0.011	0.242	0.222	848.941	0.034	0.007
Trenchers	2027	25	50	0.556	0.467	3.445	3.992	0.005	0.122	0.112	588.179	0.024	0.005
Trenchers	2027	50	75	1.209	1.016	8.262	4.698	0.005	0.577	0.530	525.626	0.021	0.004
Trenchers	2027	75	100	0.433	0.364	3.505	3.592	0.005	0.215	0.198	528.389	0.021	0.004
Trenchers	2027	100	175	0.420	0.353	3.432	3.355	0.005	0.178	0.164	526.860	0.021	0.004
Trenchers	2027	175	300	0.321	0.270	2.663	1.544	0.005	0.124	0.114	528.136	0.021	0.004
Trenchers	2027	300	600	0.199	0.167	1.528	1.585	0.005	0.065	0.060	530.689	0.022	0.004
Trenchers	2027	600	750	0.065	0.055	0.260	0.940	0.005	0.009	0.008	527.888	0.021	0.004
Trenchers	2027	750	999	1.397	1.174	13.392	14.184	0.005	0.624	0.574	528.023	0.021	0.004
Trenchers	2028	0	25	1.017	0.841	6.418	3.828	0.011	0.242	0.223	849.221	0.034	0.007
Trenchers	2028	25	50	0.532	0.447	3.399	3.997	0.005	0.110	0.102	588.492	0.024	0.005
Trenchers	2028	50	75	1.259	1.058	8.559	4.755	0.005	0.605	0.557	525.470	0.021	0.004
Trenchers	2028	75	100	0.402	0.338	3.201	3.562	0.005	0.190	0.174	528.457	0.021	0.004
Trenchers	2028	100	175	0.420	0.353	3.394	3.362	0.005	0.176	0.162	526.840	0.021	0.004
Trenchers	2028	175	300	0.313	0.263	2.560	1.525	0.005	0.119	0.110	528.904	0.021	0.004
Trenchers	2028	300	600	0.195	0.163	1.504	1.581	0.005	0.065	0.060	530.245	0.022	0.004
Trenchers	2028	600	750	0.068	0.057	0.261	0.944	0.005	0.009	0.008	527.832	0.021	0.004
Trenchers	2028	750	999	1.397	1.174	13.392	14.184	0.005	0.624	0.574	528.023	0.021	0.004
Trenchers	2029	0	25	1.017	0.841	6.416	3.827	0.011	0.242	0.222	848.889	0.034	0.007
Trenchers	2029	25	50	0.497	0.418	3.322	3.954	0.005	0.095	0.087	588.164	0.024	0.005
Trenchers	2029	50	75	1.036	0.871	7.444	4.452	0.005	0.510	0.469	523.161	0.021	0.004
Trenchers	2029	75	100	0.399	0.335	3.104	3.573	0.005	0.182	0.168	528.825	0.021	0.004
Trenchers	2029	100	175	0.426	0.358	3.406	3.379	0.005	0.176	0.162	526.740	0.021	0.004
Trenchers	2029	175	300	0.313	0.263	2.533	1.522	0.005	0.118	0.108	528.999	0.021	0.004
Trenchers	2029	300	600	0.193	0.162	1.490	1.588	0.005	0.066	0.061	530.138	0.022	0.004
Trenchers	2029	600	750	0.073	0.061	0.262	0.952	0.005	0.009	0.008	528.541	0.021	0.004
Trenchers	2029	750	999	1.397	1.174	13.392	14.184	0.005	0.624	0.574	528.023	0.021	0.004
Trenchers	2030	0	25	1.017	0.841	6.417	3.827	0.011	0.242	0.222	849.002	0.034	0.007
Trenchers	2030	25	50	0.476	0.400	3.307	3.930	0.005	0.090	0.083	588.164	0.024	0.005
Trenchers	2030	50	75	0.979	0.823	6.833	4.345	0.005	0.486	0.447	523.161	0.021	0.004
Trenchers	2030	75	100	0.388	0.326	3.023	3.568	0.005	0.177	0.163	528.825	0.021	0.004
Trenchers	2030	100	175	0.409	0.343	3.274	3.355	0.005	0.166	0.153	526.740	0.021	0.004
Trenchers	2030	175	300	0.296	0.249	2.434	1.521	0.005	0.112	0.103	528.999	0.021	0.004
Trenchers	2030	300	600	0.191	0.160	1.466	1.584	0.005	0.064	0.059	530.138	0.022	0.004
Trenchers	2030	600	750	0.073	0.061	0.262	0.952	0.005	0.009	0.008	528.541	0.021	0.004
Trenchers	2030	750	999	1.397	1.174	13.392	14.184	0.005	0.624	0.574	528.023	0.021	0.004
Trenchers	2031	0	25	1.017	0.840	6.414	3.825	0.011	0.242	0.222	848.635	0.034	0.007
Trenchers	2031	25	50	0.461	0.388	3.291	3.913	0.005	0.084	0.078	588.164	0.024	0.005
Trenchers	2031	50	75	0.946	0.795	6.598	4.265	0.005	0.477	0.439	523.161	0.021	0.004
Trenchers	2031	75	100	0.376	0.316	2.913	3.563	0.005	0.169	0.156	528.825	0.021	0.004
Trenchers	2031	100	175	0.392	0.329	3.022	3.355	0.005	0.163	0.150	526.740	0.021	0.004
Trenchers	2031	175	300	0.292	0.246	2.393	1.518	0.005	0.112	0.103	528.999	0.021	0.004
Trenchers	2031	300	600	0.191	0.160	1.462	1.584	0.005	0.064	0.059	530.138	0.022	0.004
Trenchers	2031	600	750	0.073	0.061	0.262	0.952	0.005	0.009	0.008	528.541	0.021	0.004
Trenchers	2031	750	999	1.397	1.174	13.392	14.184	0.005	0.624	0.574	528.023	0.021	0.004
Trenchers	2032	0	25	1.016	0.840	6.412	3.824	0.011	0.242	0.222	848.411	0.034	0.007
Trenchers	2032	25	50	0.447	0.376	3.275	3.896	0.005	0.079	0.073	588.164	0.024	0.005
Trenchers	2032	50	75	0.946	0.795	6.574	4.265	0.005	0.478	0.440	523.161	0.021	0.004
Trenchers	2032	75	100	0.359	0.302	2.808	3.548	0.005	0.161	0.148	528.825	0.021	0.004
Trenchers	2032	100	175	0.372	0.313	2.859	3.294	0.005	0.147	0.135	526.740	0.021	0.004
Trenchers	2032	175	300	0.273	0.229	2.216	1.480	0.005	0.099	0.091	528.999	0.021	0.004
Trenchers	2032	300	600	0.178	0.150	1.401	1.534	0.005	0.058	0.054	530.138	0.022	0.004

Unmitigated EFs from Caleemod 2022 (based on OFFROAD 2017) Appx G, Table G-11

Equipment	Year	Low HP	High HP	TOG	ROG	NOX	CO	SO2	PM10	PM2.5	CO2	CH4	N2O
Trenchers	2032	600	750	0.073	0.061	0.262	0.952	0.005	0.009	0.008	528.541	0.021	0.004
Trenchers	2032	750	999	1.397	1.174	13.392	14.184	0.005	0.624	0.574	528.023	0.021	0.004
Trenchers	2033	0	25	1.017	0.841	6.416	3.827	0.011	0.242	0.222	848.949	0.034	0.007
Trenchers	2033	25	50	0.429	0.360	3.254	3.875	0.005	0.075	0.069	588.164	0.024	0.005
Trenchers	2033	50	75	0.946	0.795	6.574	4.265	0.005	0.480	0.442	523.161	0.021	0.004
Trenchers	2033	75	100	0.341	0.287	2.730	3.534	0.005	0.148	0.136	528.825	0.021	0.004
Trenchers	2033	100	175	0.369	0.310	2.806	3.294	0.005	0.147	0.136	526.740	0.021	0.004
Trenchers	2033	175	300	0.266	0.224	2.140	1.461	0.005	0.095	0.087	528.999	0.021	0.004
Trenchers	2033	300	600	0.166	0.139	1.307	1.371	0.005	0.053	0.048	530.138	0.022	0.004
Trenchers	2033	600	750	0.073	0.061	0.262	0.952	0.005	0.009	0.008	528.541	0.021	0.004
Trenchers	2033	750	999	1.397	1.174	13.392	14.184	0.005	0.624	0.574	528.023	0.021	0.004
Trenchers	2034	0	25	1.017	0.841	6.417	3.827	0.011	0.242	0.222	849.002	0.034	0.007
Trenchers	2034	25	50	0.401	0.337	3.235	3.846	0.005	0.069	0.063	588.164	0.024	0.005
Trenchers	2034	50	75	0.932	0.783	6.448	4.239	0.005	0.458	0.421	523.161	0.021	0.004
Trenchers	2034	75	100	0.330	0.277	2.656	3.529	0.005	0.142	0.131	528.825	0.021	0.004
Trenchers	2034	100	175	0.360	0.303	2.737	3.291	0.005	0.145	0.133	526.740	0.021	0.004
Trenchers	2034	175	300	0.262	0.220	2.076	1.441	0.005	0.092	0.084	528.999	0.021	0.004
Trenchers	2034	300	600	0.154	0.129	1.234	1.321	0.005	0.047	0.044	530.138	0.022	0.004
Trenchers	2034	600	750	0.073	0.061	0.262	0.952	0.005	0.009	0.008	528.541	0.021	0.004
Trenchers	2034	750	999	1.324	1.112	12.272	14.184	0.005	0.624	0.574	528.023	0.021	0.004
Trenchers	2035	0	25	1.017	0.841	6.416	3.827	0.011	0.242	0.222	848.910	0.034	0.007
Trenchers	2035	25	50	0.385	0.323	3.218	3.829	0.005	0.065	0.060	588.164	0.024	0.005
Trenchers	2035	50	75	0.910	0.764	6.201	4.187	0.005	0.456	0.420	523.161	0.021	0.004
Trenchers	2035	75	100	0.316	0.266	2.602	3.523	0.005	0.131	0.121	528.825	0.021	0.004
Trenchers	2035	100	175	0.345	0.290	2.582	3.259	0.005	0.137	0.126	526.740	0.021	0.004
Trenchers	2035	175	300	0.256	0.215	1.969	1.425	0.005	0.089	0.082	528.999	0.021	0.004
Trenchers	2035	300	600	0.147	0.124	1.209	1.293	0.005	0.044	0.041	530.138	0.022	0.004
Trenchers	2035	600	750	0.073	0.061	0.262	0.952	0.005	0.009	0.008	528.541	0.021	0.004
Trenchers	2035	750	999	1.324	1.112	12.272	14.184	0.005	0.624	0.574	528.023	0.021	0.004
Welders	2025	0	25	0.700	0.578	4.358	2.806	0.008	0.180	0.165	568.329	0.023	0.005
Welders	2025	25	50	0.602	0.498	3.676	4.525	0.007	0.113	0.104	568.301	0.023	0.005
Welders	2026	0	25	0.693	0.573	4.335	2.796	0.008	0.176	0.162	568.341	0.023	0.005
Welders	2026	25	50	0.562	0.465	3.570	4.493	0.007	0.095	0.088	568.291	0.023	0.005
Welders	2027	0	25	0.688	0.568	4.316	2.788	0.008	0.173	0.159	568.317	0.023	0.005
Welders	2027	25	50	0.526	0.435	3.466	4.461	0.007	0.079	0.073	568.297	0.023	0.005
Welders	2028	0	25	0.683	0.565	4.299	2.782	0.008	0.170	0.157	568.314	0.023	0.005
Welders	2028	25	50	0.495	0.409	3.371	4.432	0.007	0.064	0.059	568.307	0.023	0.005
Welders	2029	0	25	0.680	0.562	4.286	2.778	0.008	0.168	0.155	568.308	0.023	0.005
Welders	2029	25	50	0.470	0.389	3.313	4.407	0.007	0.053	0.049	568.301	0.023	0.005
Welders	2030	0	25	0.678	0.561	4.277	2.775	0.008	0.166	0.153	568.333	0.023	0.005
Welders	2030	25	50	0.450	0.372	3.273	4.387	0.007	0.045	0.042	568.301	0.023	0.005
Welders	2031	0	25	0.677	0.560	4.271	2.775	0.008	0.165	0.152	568.324	0.023	0.005
Welders	2031	25	50	0.435	0.359	3.240	4.372	0.007	0.039	0.036	568.304	0.023	0.005
Welders	2032	0	25	0.677	0.559	4.267	2.775	0.008	0.164	0.151	568.336	0.023	0.005
Welders	2032	25	50	0.423	0.349	3.211	4.361	0.007	0.033	0.031	568.306	0.023	0.005
Welders	2033	0	25	0.677	0.559	4.263	2.775	0.008	0.163	0.150	568.317	0.023	0.005
Welders	2033	25	50	0.415	0.343	3.186	4.355	0.007	0.029	0.027	568.309	0.023	0.005
Welders	2034	0	25	0.676	0.559	4.261	2.775	0.008	0.163	0.150	568.307	0.023	0.005
Welders	2034	25	50	0.409	0.338	3.166	4.352	0.007	0.025	0.023	568.318	0.023	0.005

Unmitigated Lookup

Offroad Equipment (from Caleemod user's guide)

						Unmitigated Efs (in grams per hp-hr)										
year	**Equipment**	**OFFROAD Match**	**HP**	**HP Bin**	**string**	**ROG**	**NOX**	**CO**	**PM10 ex**	**PM10 d**	**PM2.5 ex**	**PM2.5 d**	**SOx**	**CO2**	**CH4**	**N2O**
2025	Derrick Barge w/ Crane	Cranes	367	599.99	2025Cranes599.99	0.20	1.95	1.66	0.08		0.07		0.005	527.58	0.02	0.0043
2025	Excavator/Backhoe	Tractors/Loaders/Backhoes	84	99.99	2025Tractors/Loaders/Backhoes99.99	0.20	2.01	3.48	0.08		0.07		0.005	529.86	0.02	0.0043
2025	Dozer	Rubber tired dozers	367	599.99	2025Rubber tired dozers599.99	0.37	3.51	2.90	0.15		0.14		0.005	532.17	0.02	0.0043
2025	Crane	Cranes	367	599.99	2025Cranes599.99	0.20	1.95	1.66	0.08		0.07		0.005	527.58	0.02	0.0043
2026	Derrick Barge w/ Crane	Cranes	367	599.99	2026Cranes599.99	0.20	1.84	1.64	0.08		0.07		0.005	527.46	0.02	0.0043
2026	Excavator/Backhoe	Tractors/Loaders/Backhoes	84	99.99	2026Tractors/Loaders/Backhoes99.99	0.18	1.88	3.48	0.06		0.06		0.005	529.71	0.02	0.0043
2026	Dozer	Rubber tired dozers	367	599.99	2026Rubber tired dozers599.99	0.35	3.22	2.73	0.14		0.13		0.005	532.55	0.02	0.0043
2026	Crane	Cranes	367	599.99	2026Cranes599.99	0.20	1.84	1.64	0.08		0.07		0.005	527.46	0.02	0.0043
2027	Derrick Barge w/ Crane	Cranes	367	599.99	2027Cranes599.99	0.19	1.75	1.63	0.07		0.07		0.005	527.45	0.02	0.0043
2027	Excavator/Backhoe	Tractors/Loaders/Backhoes	84	99.99	2027Tractors/Loaders/Backhoes99.99	0.18	1.81	3.49	0.05		0.05		0.005	529.62	0.02	0.0043
2027	Dozer	Rubber tired dozers	367	599.99	2027Rubber tired dozers599.99	0.34	3.09	2.66	0.14		0.12		0.005	532.56	0.02	0.0043
2027	Crane	Cranes	367	599.99	2027Cranes599.99	0.19	1.75	1.63	0.07		0.07		0.005	527.45	0.02	0.0043
2028	Derrick Barge w/ Crane	Cranes	367	599.99	2028Cranes599.99	0.19	1.60	1.63	0.07		0.06		0.005	527.75	0.02	0.0043
2028	Excavator/Backhoe	Tractors/Loaders/Backhoes	84	99.99	2028Tractors/Loaders/Backhoes99.99	0.17	1.75	3.50	0.05		0.04		0.005	529.57	0.02	0.0043
2028	Dozer	Rubber tired dozers	367	599.99	2028Rubber tired dozers599.99	0.34	3.04	2.66	0.13		0.12		0.005	532.86	0.02	0.0043
2028	Crane	Cranes	367	599.99	2028Cranes599.99	0.19	1.60	1.63	0.07		0.06		0.005	527.75	0.02	0.0043
2029	Derrick Barge w/ Crane	Cranes	367	599.99	2029Cranes599.99	0.18	1.48	1.61	0.06		0.06		0.005	527.61	0.02	0.0043
2029	Excavator/Backhoe	Tractors/Loaders/Backhoes	84	99.99	2029Tractors/Loaders/Backhoes99.99	0.17	1.71	3.50	0.04		0.04		0.005	529.26	0.02	0.0043
2029	Dozer	Rubber tired dozers	367	599.99	2029Rubber tired dozers599.99	0.33	2.86	2.63	0.13		0.12		0.005	532.42	0.02	0.0043
2029	Crane	Cranes	367	599.99	2029Cranes599.99	0.18	1.48	1.61	0.06		0.06		0.005	527.61	0.02	0.0043
2030	Derrick Barge w/ Crane	Cranes	367	599.99	2030Cranes599.99	0.18	1.43	1.60	0.06		0.06		0.005	527.61	0.02	0.0043
2030	Excavator/Backhoe	Tractors/Loaders/Backhoes	84	99.99	2030Tractors/Loaders/Backhoes99.99	0.17	1.68	3.50	0.04		0.04		0.005	529.26	0.02	0.0043
2030	Dozer	Rubber tired dozers	367	599.99	2030Rubber tired dozers599.99	0.33	2.77	2.67	0.13		0.12		0.005	532.38	0.02	0.0043
2030	Crane	Cranes	367	599.99	2030Cranes599.99	0.18	1.43	1.60	0.06		0.06		0.005	527.61	0.02	0.0043
2031	Derrick Barge w/ Crane	Cranes	367	599.99	2031Cranes599.99	0.17	1.35	1.59	0.06		0.05		0.005	527.61	0.02	0.0043
2031	Excavator/Backhoe	Tractors/Loaders/Backhoes	84	99.99	2031Tractors/Loaders/Backhoes99.99	0.16	1.64	3.50	0.04		0.03		0.005	529.26	0.02	0.0043
2031	Dozer	Rubber tired dozers	367	599.99	2031Rubber tired dozers599.99	0.32	2.67	2.60	0.12		0.11		0.005	532.38	0.02	0.0043
2031	Crane	Cranes	367	599.99	2031Cranes599.99	0.17	1.35	1.59	0.06		0.05		0.005	527.61	0.02	0.0043
2032	Derrick Barge w/ Crane	Cranes	367	599.99	2032Cranes599.99	0.17	1.26	1.56	0.05		0.05		0.005	527.61	0.02	0.0043
2032	Excavator/Backhoe	Tractors/Loaders/Backhoes	84	99.99	2032Tractors/Loaders/Backhoes99.99	0.16	1.61	3.50	0.03		0.03		0.005	529.26	0.02	0.0043
2032	Dozer	Rubber tired dozers	367	599.99	2032Rubber tired dozers599.99	0.30	2.41	2.33	0.11		0.10		0.005	532.42	0.02	0.0043
2032	Crane	Cranes	367	599.99	2032Cranes599.99	0.17	1.26	1.56	0.05		0.05		0.005	527.61	0.02	0.0043
2033	Derrick Barge w/ Crane	Cranes	367	599.99	2033Cranes599.99	0.16	1.18	1.56	0.05		0.04		0.005	527.61	0.02	0.0043
2033	Excavator/Backhoe	Tractors/Loaders/Backhoes	84	99.99	2033Tractors/Loaders/Backhoes99.99	0.16	1.58	3.49	0.03		0.03		0.005	529.26	0.02	0.0043
2033	Dozer	Rubber tired dozers	367	599.99	2033Rubber tired dozers599.99	0.29	2.28	2.15	0.10		0.09		0.005	532.42	0.02	0.0043
2033	Crane	Cranes	367	599.99	2033Cranes599.99	0.16	1.18	1.56	0.05		0.04		0.005	527.61	0.02	0.0043
2034	Derrick Barge w/ Crane	Cranes	367	599.99	2034Cranes599.99	0.16	1.13	1.55	0.04		0.04		0.005	527.61	0.02	0.0043
2034	Excavator/Backhoe	Tractors/Loaders/Backhoes	84	99.99	2034Tractors/Loaders/Backhoes99.99	0.16	1.57	3.49	0.03		0.03		0.005	529.26	0.02	0.0043
2034	Dozer	Rubber tired dozers	367	599.99	2034Rubber tired dozers599.99	0.29	2.21	2.12	0.10		0.09		0.005	532.42	0.02	0.0043
2034	Crane	Cranes	367	599.99	2034Cranes599.99	0.16	1.13	1.55	0.04		0.04		0.005	527.61	0.02	0.0043
2035	Derrick Barge w/ Crane	Cranes	367	599.99	2035Cranes599.99	0.15	1.05	1.51	0.04		0.04		0.005	527.61	0.02	0.0043
2035	Excavator/Backhoe	Tractors/Loaders/Backhoes	84	99.99	2035Tractors/Loaders/Backhoes99.99	0.15	1.55	3.49	0.03		0.02		0.005	529.26	0.02	0.0043
2035	Dozer	Rubber tired dozers	367	599.99	2035Rubber tired dozers599.99	0.27	2.03	1.96	0.09		0.08		0.005	532.42	0.02	0.0043
2035	Crane	Cranes	367	599.99	2035Cranes599.99	0.15	1.05	1.51	0.04		0.04		0.005	527.61	0.02	0.0043
2036	Derrick Barge w/ Crane	Cranes	367	599.99	2036Cranes599.99	0.15	0.96	1.46	0.04		0.04		0.005	527.61	0.02	0.0043
2036	Excavator/Backhoe	Tractors/Loaders/Backhoes	84	99.99	2036Tractors/Loaders/Backhoes99.99	0.15	1.53	3.49	0.02		0.02		0.005	529.26	0.02	0.0043
2036	Dozer	Rubber tired dozers	367	599.99	2036Rubber tired dozers599.99	0.26	1.89	1.81	0.08		0.07		0.005	532.42	0.02	0.0043
2036	Crane	Cranes	367	599.99	2036Cranes599.99	0.15	0.96	1.46	0.04		0.04		0.005	527.61	0.02	0.0043
2037	Derrick Barge w/ Crane	Cranes	367	599.99	2037Cranes599.99	0.14	0.90	1.40	0.04		0.04		0.005	527.61	0.02	0.0043
2037	Excavator/Backhoe	Tractors/Loaders/Backhoes	84	99.99	2037Tractors/Loaders/Backhoes99.99	0.15	1.52	3.49	0.02		0.02		0.005	529.26	0.02	0.0043
2037	Dozer	Rubber tired dozers	367	599.99	2037Rubber tired dozers599.99	0.26	1.90	1.84	0.08		0.08		0.005	532.38	0.02	0.0043
2037	Crane	Cranes	367	599.99	2037Cranes599.99	0.14	0.90	1.40	0.04		0.04		0.005	527.61	0.02	0.0043
2038	Derrick Barge w/ Crane	Cranes	367	599.99	2038Cranes599.99	0.14	0.88	1.38	0.04		0.03		0.005	527.61	0.02	0.0043
2038	Excavator/Backhoe	Tractors/Loaders/Backhoes	84	99.99	2038Tractors/Loaders/Backhoes99.99	0.15	1.50	3.49	0.02		0.02		0.005	529.26	0.02	0.0043
2038	Dozer	Rubber tired dozers	367	599.99	2038Rubber tired dozers599.99	0.25	1.70	1.63	0.07		0.07		0.005	532.42	0.02	0.0043
2038	Crane	Cranes	367	599.99	2038Cranes599.99	0.14	0.88	1.38	0.04		0.03		0.005	527.61	0.02	0.0043

Mitigation/Control Lookup

Tier 3

year	Equipment	OFFROAD Match	HP	HP Bin	string	ROG	NOX	CO	PM10 ex	PM10 d	PM2.5 ex	PM2.5 d	SOx	CO2	CH4	N2O	Tier
						Tiered EFs (in grams per hp-hr)											
2025	Derrick Barge w/ Crane	Cranes	367	599.99	2025Cranes599.99	0.09	2.32	1.66	0.09		0.08		0.005	527.58	0.02	0.0043	Tier 3
2025	Excavator/Backhoe	Tractors/Loaders/Backhoes	84	99.99	2025Tractors/Loaders/Backhoes99.99	0.09	2.74	3.48	0.11		0.10		0.005	529.86	0.02	0.0043	Tier 3
2025	Dozer	Rubber tired dozers	367	599.99	2025Rubber tired dozers599.99	0.09	2.32	2.90	0.09		0.08		0.005	532.17	0.02	0.0043	Tier 3
2025	Crane	Cranes	367	599.99	2025Cranes599.99	0.09	2.32	1.66	0.09		0.08		0.005	527.58	0.02	0.0043	Tier 3
2026	Derrick Barge w/ Crane	Cranes	367	599.99	2026Cranes599.99	0.09	2.32	1.64	0.09		0.08		0.005	527.46	0.02	0.0043	Tier 3
2026	Excavator/Backhoe	Tractors/Loaders/Backhoes	84	99.99	2026Tractors/Loaders/Backhoes99.99	0.09	2.74	3.48	0.11		0.10		0.005	529.71	0.02	0.0043	Tier 3
2026	Dozer	Rubber tired dozers	367	599.99	2026Rubber tired dozers599.99	0.09	2.32	2.73	0.09		0.08		0.005	532.55	0.02	0.0043	Tier 3
2026	Crane	Cranes	367	599.99	2026Cranes599.99	0.09	2.32	1.64	0.09		0.08		0.005	527.46	0.02	0.0043	Tier 3
2027	Derrick Barge w/ Crane	Cranes	367	599.99	2027Cranes599.99	0.09	2.32	1.63	0.09		0.08		0.005	527.45	0.02	0.0043	Tier 3
2027	Excavator/Backhoe	Tractors/Loaders/Backhoes	84	99.99	2027Tractors/Loaders/Backhoes99.99	0.09	2.74	3.49	0.11		0.10		0.005	529.62	0.02	0.0043	Tier 3
2027	Dozer	Rubber tired dozers	367	599.99	2027Rubber tired dozers599.99	0.09	2.32	2.66	0.09		0.08		0.005	532.56	0.02	0.0043	Tier 3
2027	Crane	Cranes	367	599.99	2027Cranes599.99	0.09	2.32	1.63	0.09		0.08		0.005	527.45	0.02	0.0043	Tier 3
2028	Derrick Barge w/ Crane	Cranes	367	599.99	2028Cranes599.99	0.09	2.32	1.63	0.09		0.08		0.005	527.75	0.02	0.0043	Tier 3
2028	Excavator/Backhoe	Tractors/Loaders/Backhoes	84	99.99	2028Tractors/Loaders/Backhoes99.99	0.09	2.74	3.50	0.11		0.10		0.005	529.57	0.02	0.0043	Tier 3
2028	Dozer	Rubber tired dozers	367	599.99	2028Rubber tired dozers599.99	0.09	2.32	2.66	0.09		0.08		0.005	532.86	0.02	0.0043	Tier 3
2028	Crane	Cranes	367	599.99	2028Cranes599.99	0.09	2.32	1.63	0.09		0.08		0.005	527.75	0.02	0.0043	Tier 3
2029	Derrick Barge w/ Crane	Cranes	367	599.99	2029Cranes599.99	0.09	2.32	1.61	0.09		0.08		0.005	527.61	0.02	0.0043	Tier 3
2029	Excavator/Backhoe	Tractors/Loaders/Backhoes	84	99.99	2029Tractors/Loaders/Backhoes99.99	0.09	2.74	3.50	0.11		0.10		0.005	529.26	0.02	0.0043	Tier 3
2029	Dozer	Rubber tired dozers	367	599.99	2029Rubber tired dozers599.99	0.09	2.32	2.63	0.09		0.08		0.005	532.42	0.02	0.0043	Tier 3
2029	Crane	Cranes	367	599.99	2029Cranes599.99	0.09	2.32	1.61	0.09		0.08		0.005	527.61	0.02	0.0043	Tier 3
2030	Derrick Barge w/ Crane	Cranes	367	599.99	2030Cranes599.99	0.09	2.32	1.60	0.09		0.08		0.005	527.61	0.02	0.0043	Tier 3
2030	Excavator/Backhoe	Tractors/Loaders/Backhoes	84	99.99	2030Tractors/Loaders/Backhoes99.99	0.09	2.74	3.50	0.11		0.10		0.005	529.26	0.02	0.0043	Tier 3
2030	Dozer	Rubber tired dozers	367	599.99	2030Rubber tired dozers599.99	0.09	2.32	2.67	0.09		0.08		0.005	532.38	0.02	0.0043	Tier 3
2030	Crane	Cranes	367	599.99	2030Cranes599.99	0.09	2.32	1.60	0.09		0.08		0.005	527.61	0.02	0.0043	Tier 3
2031	Derrick Barge w/ Crane	Cranes	367	599.99	2031Cranes599.99	0.09	2.32	1.59	0.09		0.08		0.005	527.61	0.02	0.0043	Tier 3
2031	Excavator/Backhoe	Tractors/Loaders/Backhoes	84	99.99	2031Tractors/Loaders/Backhoes99.99	0.09	2.74	3.50	0.11		0.10		0.005	529.26	0.02	0.0043	Tier 3
2031	Dozer	Rubber tired dozers	367	599.99	2031Rubber tired dozers599.99	0.09	2.32	2.60	0.09		0.08		0.005	532.38	0.02	0.0043	Tier 3
2031	Crane	Cranes	367	599.99	2031Cranes599.99	0.09	2.32	1.59	0.09		0.08		0.005	527.61	0.02	0.0043	Tier 3
2032	Derrick Barge w/ Crane	Cranes	367	599.99	2032Cranes599.99	0.09	2.32	1.56	0.09		0.08		0.005	527.61	0.02	0.0043	Tier 3
2032	Excavator/Backhoe	Tractors/Loaders/Backhoes	84	99.99	2032Tractors/Loaders/Backhoes99.99	0.09	2.74	3.50	0.11		0.10		0.005	529.26	0.02	0.0043	Tier 3
2032	Dozer	Rubber tired dozers	367	599.99	2032Rubber tired dozers599.99	0.09	2.32	2.33	0.09		0.08		0.005	532.42	0.02	0.0043	Tier 3
2032	Crane	Cranes	367	599.99	2032Cranes599.99	0.09	2.32	1.56	0.09		0.08		0.005	527.61	0.02	0.0043	Tier 3
2033	Derrick Barge w/ Crane	Cranes	367	599.99	2033Cranes599.99	0.09	2.32	1.56	0.09		0.08		0.005	527.61	0.02	0.0043	Tier 3
2033	Excavator/Backhoe	Tractors/Loaders/Backhoes	84	99.99	2033Tractors/Loaders/Backhoes99.99	0.09	2.74	3.49	0.11		0.10		0.005	529.26	0.02	0.0043	Tier 3
2033	Dozer	Rubber tired dozers	367	599.99	2033Rubber tired dozers599.99	0.09	2.32	2.15	0.09		0.08		0.005	532.42	0.02	0.0043	Tier 3
2033	Crane	Cranes	367	599.99	2033Cranes599.99	0.09	2.32	1.56	0.09		0.08		0.005	527.61	0.02	0.0043	Tier 3
2034	Derrick Barge w/ Crane	Cranes	367	599.99	2034Cranes599.99	0.09	2.32	1.55	0.09		0.08		0.005	527.61	0.02	0.0043	Tier 3
2034	Excavator/Backhoe	Tractors/Loaders/Backhoes	84	99.99	2034Tractors/Loaders/Backhoes99.99	0.09	2.74	3.49	0.11		0.10		0.005	529.26	0.02	0.0043	Tier 3
2034	Dozer	Rubber tired dozers	367	599.99	2034Rubber tired dozers599.99	0.09	2.32	2.12	0.09		0.08		0.005	532.42	0.02	0.0043	Tier 3
2034	Crane	Cranes	367	599.99	2034Cranes599.99	0.09	2.32	1.55	0.09		0.08		0.005	527.61	0.02	0.0043	Tier 3
2035	Derrick Barge w/ Crane	Cranes	367	599.99	2035Cranes599.99	0.09	2.32	1.51	0.09		0.08		0.005	527.61	0.02	0.0043	Tier 3
2035	Excavator/Backhoe	Tractors/Loaders/Backhoes	84	99.99	2035Tractors/Loaders/Backhoes99.99	0.09	2.74	3.49	0.11		0.10		0.005	529.26	0.02	0.0043	Tier 3
2035	Dozer	Rubber tired dozers	367	599.99	2035Rubber tired dozers599.99	0.09	2.32	1.96	0.09		0.08		0.005	532.42	0.02	0.0043	Tier 3
2035	Crane	Cranes	367	599.99	2035Cranes599.99	0.09	2.32	1.51	0.09		0.08		0.005	527.61	0.02	0.0043	Tier 3
2036	Derrick Barge w/ Crane	Cranes	367	599.99	2036Cranes599.99	0.09	2.32	1.46	0.09		0.08		0.005	527.61	0.02	0.0043	Tier 3
2036	Excavator/Backhoe	Tractors/Loaders/Backhoes	84	99.99	2036Tractors/Loaders/Backhoes99.99	0.09	2.74	3.49	0.11		0.10		0.005	529.26	0.02	0.0043	Tier 3
2036	Dozer	Rubber tired dozers	367	599.99	2036Rubber tired dozers599.99	0.09	2.32	1.81	0.09		0.08		0.005	532.42	0.02	0.0043	Tier 3
2036	Crane	Cranes	367	599.99	2036Cranes599.99	0.09	2.32	1.46	0.09		0.08		0.005	527.61	0.02	0.0043	Tier 3
2037	Derrick Barge w/ Crane	Cranes	367	599.99	2037Cranes599.99	0.09	2.32	1.40	0.09		0.08		0.005	527.61	0.02	0.0043	Tier 3
2037	Excavator/Backhoe	Tractors/Loaders/Backhoes	84	99.99	2037Tractors/Loaders/Backhoes99.99	0.09	2.74	3.49	0.11		0.10		0.005	529.26	0.02	0.0043	Tier 3
2037	Dozer	Rubber tired dozers	367	599.99	2037Rubber tired dozers599.99	0.09	2.32	1.84	0.09		0.08		0.005	532.38	0.02	0.0043	Tier 3
2037	Crane	Cranes	367	599.99	2037Cranes599.99	0.09	2.32	1.40	0.09		0.08		0.005	527.61	0.02	0.0043	Tier 3
2038	Derrick Barge w/ Crane	Cranes	367	599.99	2038Cranes599.99	0.09	2.32	1.38	0.09		0.08		0.005	527.61	0.02	0.0043	Tier 3
2038	Excavator/Backhoe	Tractors/Loaders/Backhoes	84	99.99	2038Tractors/Loaders/Backhoes99.99	0.09	2.74	3.49	0.11		0.10		0.005	529.26	0.02	0.0043	Tier 3
2038	Dozer	Rubber tired dozers	367	599.99	2038Rubber tired dozers599.99	0.09	2.32	1.63	0.09		0.08		0.005	532.42	0.02	0.0043	Tier 3
2038	Crane	Cranes	367	599.99	2038Cranes599.99	0.09	2.32	1.38	0.09		0.08		0.005	527.61	0.02	0.0043	Tier 3

schedule

Phase	Activity	Start	End	Working Days	Equipment	Quantity	OFFROAD	2025	2026
1-1	Demolition (Over-Water)	7/1/2025	9/9/2025	60	Derrick Barge w/ Crane	1	Cranes	60	
1-2	Demolition (In-Water)	9/10/2025	11/19/2025	60	Derrick Barge w/ Crane	1	Cranes	60	
1-3	Pier (In-Water)	9/10/2025	12/3/2025	72	Derrick Barge w/ Crane	1	Cranes	72	
1-4	Breakwater/Dolphin (In-Water)	12/4/2025	1/15/2026	36	Derrick Barge w/ Crane	1	Cranes	36	
1-5	Pier (Over-Water)	1/1/2026	4/23/2026	96	Derrick Barge w/ Crane	1	Cranes		96
1-6	Breakwater/Dolphin (Over-Water)	4/24/2026	7/17/2026	72	Derrick Barge w/ Crane	1	Cranes		72
1-7	Small Boat Basin	7/18/2026	9/26/2026	60	Derrick Barge w/ Crane	1	Cranes		60
1-8	Marine Yard	9/27/2026	12/20/2026	72	Crane	1	Cranes		72
1-8	Marine Yard	9/27/2026	12/20/2026	72	Excavator/Backhoe	1	Tractors/Loaders/Backhoes		72
1-8	Marine Yard	9/27/2026	12/20/2026	72	Dozer	0	Rubber tired dozers		72
								12/31/2025	12/31/2026

Phase	Activity	Start	End	Working Days	Equipment	Quantity	OFFROAD	2027
2-1	Dredging	1/1/2027	2/26/2027	48	Derrick Barge w/ Crane	2	Cranes	48
2-2	Dock / Breakwater (In-Water)	2/27/2027	6/5/2027	84	Derrick Barge w/ Crane	1	Cranes	84
2-3	Dock / Breakwater (Over-Water)	6/6/2027	8/29/2027	72	Derrick Barge w/ Crane	1	Cranes	72
2-4	Small Boat Basin #2	8/30/2027	12/6/2027	84	Derrick Barge w/ Crane	1	Cranes	84
2-5	Marine/Naval Modulars	9/10/2027	12/31/2027	96	Crane	1	Cranes	96
2-5	Marine/Naval Modulars	9/10/2027	12/31/2027	96	Excavator/Backhoe	2	Tractors/Loaders/Backhoes	96
2-5	Marine/Naval Modulars	9/10/2027	12/31/2027	96	Dozer	1	Rubber tired dozers	96
								12/31/2027

Phase	Activity	Start	End	Working Days	Equipment	Quantity	OFFROAD	2030	2031	2032
3-1	Dredging	1/1/2030	1/29/2030	24	Derrick Barge w/ Crane	1	Cranes	24		
3-2	Breakwaters (In-Water)	1/30/2030	5/8/2030	84	Derrick Barge w/ Crane	1	Cranes	84		
3-3	Observation Docks	5/9/2030	6/20/2030	36	Derrick Barge w/ Crane	1	Cranes	36		
3-4	Row House (In-Water)	6/21/2030	7/19/2030	24	Derrick Barge w/ Crane	1	Cranes	24		
3-5	Row House (Over-Water)	7/20/2030	11/9/2030	96	Derrick Barge w/ Crane	1	Cranes	96		
3-6	Marine Yard Upgrades	11/10/2030	2/16/2031	84	Crane	1	Cranes	51	33	
3-6	Marine Yard Upgrades	11/10/2030	2/16/2031	84	Excavator/Backhoe	2	Tractors/Loaders/Backhoes	51	33	
3-6	Marine Yard Upgrades	11/10/2030	2/16/2031	84	Dozer	2	Rubber tired dozers	51	33	
3-7	New Building	1/1/2031	4/7/2032	396	Crane	1	Cranes		312	84
3-7	New Building	1/1/2031	4/7/2032	396	Excavator/Backhoe	2	Tractors/Loaders/Backhoes		312	84
3-7	New Building	1/1/2031	4/7/2032	396	Dozer	1	Rubber tired dozers		312	84
3-8	Hydro Kinetic Barge (in-Water)	4/8/2032	5/20/2032	36	Derrick Barge w/ Crane	1	Cranes			36
3-9	Hydro Kinetic Barge (Over-Water)	5/21/2032	6/18/2032	24	Crane	1	Cranes			24
3-9	Hydro Kinetic Barge (Over-Water)	5/21/2032	6/18/2032	24	Excavator/Backhoe	2	Tractors/Loaders/Backhoes			24
								12/31/2030	12/31/2031	12/31/2032

Equipment Assignments

Equipment	offroad match	onroad match	harbor craft match
Derrick Barge w/ Crane	Cranes		barge - other
Workboats			workboats
Flat Deck Barge			barge - other
Tugboat			push/pull tug
Dump Truck		HHDT	
Sectional Barges			barge - other
Concrete		HHDT	
Crane	Cranes		
Excavator/Backhoe	Tractors/Loaders/Backhoes		
Dozer	Rubber tired dozers		
Workers		LDA/LDT1/LDT2	
Work Trucks			

Onroad Calculations

Summary - Onroad Emissions

		Total Tons						Average Lbs Per Day					
		ROG	**NOX**	**CO**	**PM10 ex**	**PM2.5 ex**	**Working Days**	**ROG**	**NOX**	**CO**	**PM10 ex**	**PM2.5 ex**	
Phase 1	2025	0.033	0.03	0.30	5E-04	4E-04	170	0.39	0.40	3.50	0.01	0.01	1
	2026	0.056	0.06	0.50	9E-04	8E-04	303	0.37	0.41	3.29	0.01	0.01	1
Phase 2	2027	0.055	0.06	0.48	9E-04	8E-04	312	0.35	0.38	3.06	0.01	0.01	2
Phase 3	2030	0.047	0.04	0.40	6E-04	6E-04	312	0.30	0.24	2.54	0.00	0.00	3
	2031	0.045	0.04	0.38	6E-04	6E-04	312	0.29	0.23	2.41	0.00	0.00	3
	2032	0.020	0.01	0.16	2E-04	2E-04	145	0.27	0.18	2.27	0.00	0.00	3

GHG		Total MT
		CO2e
Phase 1	2025	71
	2026	126
Phase 2	2027	128
Phase 3	2030	112
	2031	110
	2032	48
	Total	595

Gallons			
		Diesel	**Gasoline**
Concrete Trucks		598	
Debris Trucks		3803	
Workers			63611
		4401	63611

		Emisssions (in tons per year)											Emissions (in MT per year)							
		ROG	NOX	CO	PM10 ex	PM10 d	PM2.5 ex	PM2.5 d	SOx	CO2	CH4	N2O	CO2	CH4	N2O	CO2e	Fuel Gallons	Diesel PM (tons)	*Phase*	*Year*
Concrete Trucks	1-1_2025	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00E+00	*1*	*2025*
	1-2_2025	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00E+00	*1*	*2025*
	1-3_2025	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00E+00	*1*	*2025*
	1-4_2025	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00E+00	*1*	*2025*
	1-5_2026	7.32579E-05	0.004537	0.000735019	6.05287E-05	0.000250548	5.79103E-05	7.98715E-05	3.32764E-05	3.514102	3.40264E-06	0.000553648	3.18794	3.08682E-06	0.000502261	3.337691	326.2876	5.79E-05	*1*	*2026*
	1-6_2026	2.34425E-05	0.001452	0.000235206	1.93692E-05	8.01754E-05	1.85313E-05	2.55589E-05	1.06485E-05	1.124513	1.08884E-06	0.000177167	1.020141	9.87783E-07	0.000160724	1.068061	104.412	1.85E-05	*1*	*2026*
	1-7_2026	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00E+00	*1*	*2026*
	1-8_2026	8.68241E-06	0.000538	8.71134E-05	7.17378E-06	2.96946E-05	6.86344E-06	9.46625E-06	3.94387E-06	0.416486	4.03276E-07	6.56176E-05	0.37783	3.65846E-07	5.95273E-05	0.395578	38.67112	6.86E-06	*1*	*2026*
	2-1_2027	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00E+00	*2*	*2027*
	2-2_2027	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00E+00	*2*	*2027*
	2-3_2027	2.88844E-05	0.001767	0.0002907	2.40931E-05	0.000100682	2.30509E-05	3.211E-05	1.30853E-05	1.381848	1.34161E-06	0.000217711	1.253591	1.21708E-06	0.000197504	1.312478	128.3714	2.31E-05	*2*	*2027*
	2-4_2027	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00E+00	*2*	*2027*
	2-5_2027	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00E+00	*2*	*2027*
	3-1_2030	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00E+00	*3*	*2030*
	3-2_2030	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00E+00	*3*	*2030*
	3-3_2030	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00E+00	*3*	*2030*
	3-4_2030	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00E+00	*3*	*2030*
	3-5_2030	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00E+00	*3*	*2030*
	3-6_2030	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00E+00	*3*	*2030*
	3-6_2031	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00E+00	*3*	*2031*
	3-7_2031	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00E+00	*3*	*2031*
	3-7_2032	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00E+00	*3*	*2032*
	3-8_2032	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00E+00	*3*	*2032*
	3-9_2032	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.00E+00	*3*	*2032*
Concrete Truck Idle	1-1_2025	0.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*1*	*2025*
	1-2_2025	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*1*	*2025*
	1-3_2025	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*1*	*2025*
	1-4_2025	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*1*	*2025*
	1-5_2026	0.000163121	0.001899	0.002387329	8.80259E-07	0	8.4218E-07	0	3.50897E-06	0.367799	7.57655E-06	0	0.333661	6.87333E-06	0	0.333833	0	8.4218E-07	*1*	*2026*
	1-6_2026	5.21988E-05	0.000608	0.000763945	2.81683E-07	0	2.69498E-07	0	1.12287E-06	0.117696	2.4245E-06	0	0.106772	2.19947E-06	0	0.106827	0	2.69498E-07	*1*	*2026*
	1-7_2026	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*1*	*2026*
	1-8_2026	1.93329E-05	0.000225	0.000282943	1.04327E-07	0	9.98139E-08	0	4.15878E-07	0.043591	8.97962E-07	0	0.039545	8.14617E-07	0	0.039565	0	9.98139E-08	*1*	*2026*
	2-1_2027	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*2*	*2027*
	2-2_2027	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*2*	*2027*
	2-3_2027	6.52484E-05	0.000759	0.000954932	3.52104E-07	0	3.36872E-07	0	1.40359E-06	0.14712	3.03062E-06	0	0.133465	2.74933E-06	0	0.133533	0	3.36872E-07	*2*	*2027*
	2-4_2027	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*2*	*2027*
	2-5_2027	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*2*	*2027*
	3-1_2030	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*3*	*2030*
	3-2_2030	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*3*	*2030*
	3-3_2030	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*3*	*2030*
	3-4_2030	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*3*	*2030*
	3-5_2030	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*3*	*2030*
	3-6_2030	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*3*	*2030*
	3-6_2031	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*3*	*2031*
	3-7_2031	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*3*	*2031*
	3-7_2032	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*3*	*2032*
	3-8_2032	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*3*	*2032*
	3-9_2032	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*3*	*2032*
Debris Trucks	1-1_2025	0.00	0.00212	0.000338492	2.76576E-05	0.000113523	2.64611E-05	3.61786E-05	1.53633E-05	1.622416	1.57157E-06	0.000255612	1.471831	1.42571E-06	0.000231888	1.540969	150.5596	2.64611E-05	*1*	*2025*
	1-2_2025	3.38355E-05	0.00212	0.000338492	2.76576E-05	0.000113523	2.64611E-05	3.61786E-05	1.53633E-05	1.622416	1.57157E-06	0.000255612	1.471831	1.42571E-06	0.000231888	1.540969	150.5596	2.64611E-05	*1*	*2025*
	1-3_2025	4.06026E-05	0.002544	0.00040619	3.31891E-05	0.000136227	3.17534E-05	4.34143E-05	1.8436E-05	1.946899	1.88589E-06	0.000306735	1.766197	1.71085E-06	0.000278265	1.849163	180.6715	3.17534E-05	*1*	*2025*
	1-4_2025	2.03013E-05	0.001272	0.000203095	1.65946E-05	6.81136E-05	1.58767E-05	2.17071E-05	9.21799E-06	0.97345	9.42943E-07	0.000153367	0.883099	8.55423E-07	0.000139133	0.924582	90.33576	1.58767E-05	*1*	*2025*
	1-5_2026	5.32785E-05	0.0033	0.000534559	4.40209E-05	0.000182217	4.21166E-05	5.80883E-05	2.4201E-05	2.55571	2.47465E-06	0.000402653	2.318501	2.24496E-06	0.000365281	2.427411	237.3001	4.21166E-05	*1*	*2026*
	1-6_2026	3.99588E-05	0.002475	0.000400919	3.30157E-05	0.000136663	3.15874E-05	4.35663E-05	1.81508E-05	1.916783	1.85598E-06	0.00030199	1.738876	1.68372E-06	0.000273961	1.820558	177.9751	3.15874E-05	*1*	*2026*
	1-7_2026	3.3299E-05	0.002062	0.0003341	2.75131E-05	0.000113886	2.63229E-05	3.63052E-05	1.51257E-05	1.597319	1.54665E-06	0.000251658	1.449063	1.4031E-06	0.000228301	1.517132	148.3125	2.63229E-05	*1*	*2026*
	1-8_2026	3.99588E-05	0.002475	0.000400919	3.30157E-05	0.000136663	3.15874E-05	4.35663E-05	1.81508E-05	1.916783	1.85598E-06	0.00030199	1.738876	1.68372E-06	0.000273961	1.820558	177.9751	3.15874E-05	*1*	*2026*
	2-1_2027	3.61055E-05	0.002209	0.000363375	3.01164E-05	0.000125852	2.88136E-05	4.01375E-05	1.63566E-05	1.72731	1.67701E-06	0.000272138	1.566989	1.52136E-06	0.00024688	1.640597	160.4643	2.88136E-05	*2*	*2027*
	2-2_2027	6.31847E-05	0.003865	0.000635907	5.27037E-05	0.000220241	5.04238E-05	7.02406E-05	2.8624E-05	3.022792	2.93476E-06	0.000476242	2.742231	2.66237E-06	0.00043204	2.871045	280.8124	5.04238E-05	*2*	*2027*
	2-3_2027	5.41583E-05	0.003313	0.000545063	4.51746E-05	0.000188778	4.32204E-05	6.02063E-05	2.45349E-05	2.590964	2.51551E-06	0.000408207	2.350483	2.28203E-06	0.00037032	2.460896	240.6964	4.32204E-05	*2*	*2027*
	2-4_2027	6.31847E-05	0.003865	0.000635907	5.27037E-05	0.000220241	5.04238E-05	7.02406E-05	2.8624E-05	3.022792	2.93476E-06	0.000476242	2.742231	2.66237E-06	0.00043204	2.871045	280.8124	5.04238E-05	*2*	*2027*
	2-5_2027	7.22111E-05	0.004417	0.00072675	6.02328E-05	0.000251704	5.76272E-05	8.0275E-05	3.27132E-05	3.454619	3.35402E-06	0.000544277	3.133978	3.04271E-06	0.000493759	3.281194	320.9285	5.76272E-05	*2*	*2027*
	3-1_2030	8.32581E-06	0.000492	8.46029E-05	7.09969E-06	3.04618E-05	6.79256E-06	9.72713E-06	3.70352E-06	0.391104	3.86712E-07	6.16186E-05	0.354804	3.5082E-07	5.58995E-05	0.371471	36.37537	6.79256E-06	*3*	*2030*
	3-2_2030	2.91403E-05	0.001721	0.00029611	2.48489E-05	0.000106616	2.3774E-05	3.4045E-05	1.29623E-05	1.368864	1.35349E-06	0.000215665	1.241813	1.22787E-06	0.000195648	1.300147	127.3138	2.3774E-05	*3*	*2030*
	3-3_2030	1.24887E-05	0.000738	0.000126904	1.06495E-05	4.56927E-05	1.01888E-05	1.45907E-05	5.55528E-06	0.586656	5.80069E-07	9.24279E-05	0.532206	5.26229E-07	8.38492E-05	0.557206	54.56306	1.01888E-05	*3*	*2030*
	3-4_2030	8.32581E-06	0.000492	8.46029E-05	7.09969E-06	3.04618E-05	6.79256E-06	9.72713E-06	3.70352E-06	0.391104	3.86712E-07	6.16186E-05	0.354804	3.5082E-07	5.58995E-05	0.371471	36.37537	6.79256E-06	*3*	*2030*
	3-5_2030	3.33032E-05	0.001967	0.000338412	2.83987E-05	0.000121847	2.71702E-05	3.89085E-05	1.48141E-05	1.564416	1.54685E-06	0.000246474	1.419215	1.40328E-06	0.000223598	1.485882	145.5015	2.71702E-05	*3*	*2030*
	3-6_2030	2.91403E-05	0.001721	0.00029611	2.48489E-05	0.000106616	2.3774E-05	3.4045E-05	1.29623E-05	1.368864	1.35349E-06	0.000215665	1.241813	1.22787E-06	0.000195648	1.300147	127.3138	2.3774E-05	*3*	*2030*
	3-6_2031	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*3*	*2031*
	3-7_2031	0.000136035	0.007974	0.001388263	0.00011676	0.000504701	0.000111709	0.000161222	6.01011E-05	6.346877	6.31848E-06	0.000999953	5.75779	5.73203E-06	0.000907142	6.028261	590.3698	0.000111709	*3*	*2031*
	3-7_2032	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*3*	*2032*
	3-8_2032	1.22631E-05	0.000714	0.000125674	1.05821E-05	4.60708E-05	1.01243E-05	1.47222E-05	5.38127E-06	0.56828	5.6959E-07	8.95328E-05	0.515535	5.16723E-07	8.12228E-05	0.539752	52.86431	1.01243E-05	*3*	*2032*
	3-9_2032	8.17541E-06	0.000476	8.37826E-05	7.05473E-06	3.07139E-05	6.74954E-06	9.81478E-06	3.58752E-06	0.378853	3.79727E-07	5.96885E-05	0.34369	3.44482E-07	5.41485E-05	0.359835	35.24288	6.74954E-06	*3*	*2032*

		Emisssions (in tons per year)											Emissions (in MT per year)				Fuel Gallons	Diesel PM (tons)	Phase	Year
		ROG	NOX	CO	PM10 ex	PM10 d	PM2.5 ex	PM2.5 d	SOx	CO2	CH4	N2O	CO2	CH4	N2O	CO2e				
Workers	1-1_2025	0.03	0.025802	0.296252656	0.000367488	0.003142273	0.000338068	0.000924396	0.00069744	70.55174	0.002687124	0.002310803	64.00346	0.002437718	0.002096325	64.68911	7495.067	0	*1*	*2025*
	1-2_2025	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*1*	*2025*
	1-3_2025	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*1*	*2025*
	1-4_2025	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*1*	*2025*
	1-5_2026	0.055517543	0.041815	0.492443078	0.000625983	0.005598772	0.000575843	0.001646946	0.001215806	122.9886	0.004452563	0.003874426	111.5734	0.004039297	0.00351482	112.7218	13061.64	0	*1*	*2026*
	1-6_2026	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*1*	*2026*
	1-7_2026	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*1*	*2026*
	1-8_2026	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*1*	*2026*
	2-1_2027	0.054379402	0.039232	0.473967005	0.000610818	0.005762236	0.000561809	0.001694872	0.001224578	123.8757	0.004269953	0.003764843	112.3782	0.003873636	0.003415408	113.4928	13151.65	0	*2*	*2027*
	2-2_2027	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*2*	*2027*
	2-3_2027	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*2*	*2027*
	2-4_2027	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*2*	*2027*
	2-5_2027	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*2*	*2027*
	3-1_2030	0.047273828	0.030226	0.394780659	0.000509515	0.005750125	0.000468569	0.001690633	0.001149375	116.268	0.003490916	0.003233469	105.4766	0.003166906	0.002933354	106.4299	12334.06	0	*3*	*2030*
	3-2_2030	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*3*	*2030*
	3-3_2030	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*3*	*2030*
	3-4_2030	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*3*	*2030*
	3-5_2030	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*3*	*2030*
	3-6_2030	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*3*	*2030*
	3-6_2031	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*3*	*2031*
	3-7_2031	0.044833115	0.027681	0.373809973	0.000476618	0.005806476	0.000438315	0.001710356	0.001124703	113.7722	0.0032645	0.003086441	103.2124	0.002961504	0.002799972	104.1208	12066.4	0	*3*	*2031*
	3-7_2032	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*3*	*2032*
	3-8_2032	0.019812096	0.011891	0.164693318	0.000207349	0.002695842	0.000190683	0.000793939	0.000513018	51.89554	0.001423724	0.001376684	47.07885	0.001291581	0.001248907	47.48331	5502.671	0	*3*	*2032*
	3-9_2032	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*3*	*2032*

Concrete Trucks Movement

Phase #	Phase	Year	# Concrete Trucks	VMT per 1-way trip	Trips Per Truck	Total VMT	Total Trips	Emisssions (in tons per year)											Emissions (in MT per year)				Fuel Gallons	Diesel PM (tons)
								ROG	NOX	CO	PM10 ex	PM10 d	PM2.5 ex	PM2.5 d	SOx	CO2	CH4	N2O	CO2	CH4	N2O	CO2e		
1-1	Demolition (Over-Water)	2025	0	20	2	0	0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0.00	0	0.0000
1-2	Demolition (In-Water)	2025	0	20	2	0	0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0.00	0	0.0000
1-3	Pier (In-Water)	2025	0	20	2	0	0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0.00	0	0.0000
1-4	Breakwater/Dolphin (In-Water)	2025	0	20	2	0	0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0.00	0	0.0000
1-5	Pier (Over-Water)	2026	50	20	2	2000	100	0.0001	0.0045	0.0007	0.0001	0.0003	0.0001	0.0001	0.0000	3.5141	0.0000	0.0006	3.19	0.00	0.00	3.34	326	0.0001
1-6	Breakwater/Dolphin (Over-Water)	2026	16	20	2	640	32	0.0000	0.0015	0.0002	0.0000	0.0001	0.0000	0.0000	0.0000	1.1245	0.0000	0.0002	1.02	0.00	0.00	1.07	104	0.0000
1-7	Small Boat Basin	2026	0	20	2	0	0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0.00	0	0.0000
1-8	Marine Yard	2026	2	20	2	79	4	0.0000	0.0002	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1388	0.0000	0.0000	0.13	0.00	0.00	0.13	13	0.0000
1-8	Marine Yard	2026	2	20	2	79	4	0.0000	0.0002	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1388	0.0000	0.0000	0.13	0.00	0.00	0.13	13	0.0000
1-8	Marine Yard	2026	2	20	2	79	4	0.0000	0.0002	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1388	0.0000	0.0000	0.13	0.00	0.00	0.13	13	0.0000
2-1	Dredging	2027	0	20	2	0	0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0.00	0	0.0000
2-2	Dock / Breakwater (In-Water)	2027	0	20	2	0	0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0.00	0	0.0000
2-3	Dock / Breakwater (Over-Water)	2027	20	20	2	800	40	0.0000	0.0018	0.0003	0.0000	0.0001	0.0000	0.0000	0.0000	1.3818	0.0000	0.0002	1.25	0.00	0.00	1.31	128	0.0000
2-4	Small Boat Basin #2	2027	0	20	2	0	0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0.00	0	0.0000
2-5	Marine/Naval Modulars	2027	0	20	2	0	0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0.00	0	0.0000
2-5	Marine/Naval Modulars	2027	0	20	2	0	0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0.00	0	0.0000
2-5	Marine/Naval Modulars	2027	0	20	2	0	0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0.00	0	0.0000
3-1	Dredging	2030	0	20	2	0	0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0.00	0	0.0000
3-2	Breakwaters (In-Water)	2030	0	20	2	0	0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0.00	0	0.0000
3-3	Observation Docks	2030	0	20	2	0	0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0.00	0	0.0000
3-4	Row House (In-Water)	2030	0	20	2	0	0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0.00	0	0.0000
3-5	Row House (Over-Water)	2030	0	20	2	0	0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0.00	0	0.0000
3-6	Marine Yard Upgrades	2030	0	20	2	0	0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0.00	0	0.0000
3-6	Marine Yard Upgrades	2030	0	20	2	0	0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0.00	0	0.0000
3-6	Marine Yard Upgrades	2030	0	20	2	0	0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0.00	0	0.0000
3-7	New Building	2031	0	20	2	0	0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0.00	0	0.0000
3-7	New Building	2031	0	20	2	0	0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0.00	0	0.0000
3-7	New Building	2031	0	20	2	0	0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0.00	0	0.0000
3-8	Hydro Kinetic Barge (in-Water)	2032	0	20	2	0	0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0.00	0	0.0000
3-9	Hydro Kinetic Barge (Over-Water)	2032	0	20	2	0	0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0.00	0	0.0000

Concrete Truck Idling Onsite

						Emisssions (in tons per year)											Emissions (in MT per year)					
Phase #	Phase	Year	# Concrete Trucks	Idle time per truck (in hours)	Total Idle Hours	ROG	NOX	CO	PM10 ex	PM10 d	PM2.5 ex	PM2.5 d	SOx	CO2	CH4	N2O	CO2	CH4	N2O	CO2e	Fuel Gallons	Diesel PM (tons)
1-1	Demolition (Over-Water)	2025	0	1.25	0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0.00		0.0000
1-2	Demolition (In-Water)	2025	0	1.25	0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0.00		0.0000
1-3	Pier (In-Water)	2025	0	1.25	0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0.00		0.0000
1-4	Breakwater/Dolphin (In-Water)	2025	0	1.25	0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0.00		0.0000
1-5	Pier (Over-Water)	2026	50	1.25	63	0.0002	0.0019	0.0024	0.0000	0.0000	0.0000	0.0000	0.0000	0.3678	0.0000	0.0000	0.33	0.00	0.00	0.33		0.0000
1-6	Breakwater/Dolphin (Over-Water)	2026	16	1.25	20	0.0001	0.0006	0.0008	0.0000	0.0000	0.0000	0.0000	0.0000	0.1177	0.0000	0.0000	0.11	0.00	0.00	0.11		0.0000
1-7	Small Boat Basin	2026	0	1.25	0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0.00		0.0000
1-8	Marine Yard	2026	2	1.25	2	0.0000	0.0001	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0145	0.0000	0.0000	0.01	0.00	0.00	0.01		0.0000
1-8	Marine Yard	2026	2	1.25	2	0.0000	0.0001	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0145	0.0000	0.0000	0.01	0.00	0.00	0.01		0.0000
1-8	Marine Yard	2026	2	1.25	2	0.0000	0.0001	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0145	0.0000	0.0000	0.01	0.00	0.00	0.01		0.0000
2-1	Dredging	2027	0	1.25	0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0.00		0.0000
2-2	Dock / Breakwater (In-Water)	2027	0	1.25	0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0.00		0.0000
2-3	Dock / Breakwater (Over-Water)	2027	20	1.25	25	0.0001	0.0008	0.0010	0.0000	0.0000	0.0000	0.0000	0.0000	0.1471	0.0000	0.0000	0.13	0.00	0.00	0.13		0.0000
2-4	Small Boat Basin #2	2027	0	1.25	0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0.00		0.0000
2-5	Marine/Naval Modulars	2027	0	1.25	0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0.00		0.0000
2-5	Marine/Naval Modulars	2027	0	1.25	0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0.00		0.0000
2-5	Marine/Naval Modulars	2027	0	1.25	0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0.00		0.0000
3-1	Dredging	2030	0	1.25	0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0.00		0.0000
3-2	Breakwaters (In-Water)	2030	0	1.25	0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0.00		0.0000
3-3	Observation Docks	2030	0	1.25	0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0.00		0.0000
3-4	Row House (In-Water)	2030	0	1.25	0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0.00		0.0000
3-5	Row House (Over-Water)	2030	0	1.25	0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0.00		0.0000
3-6	Marine Yard Upgrades	2030	0	1.25	0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0.00		0.0000
3-6	Marine Yard Upgrades	2030	0	1.25	0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0.00		0.0000
3-6	Marine Yard Upgrades	2030	0	1.25	0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0.00		0.0000
3-7	New Building	2031	0	1.25	0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0.00		0.0000
3-7	New Building	2031	0	1.25	0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0.00		0.0000
3-7	New Building	2031	0	1.25	0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0.00		0.0000
3-8	Hydro Kinetic Barge (in-Water)	2032	0	1.25	0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0.00		0.0000
3-9	Hydro Kinetic Barge (Over-Water)	2032	0	1.25	0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0.00		0.0000

Debris Trucks

								Emisssions (in tons per year)											Emissions (in MT per year)					
Phase #	Phase	Year	# Debris Trucks	VMT per 1-way trip	Trips Per Truck	Total VMT	Total Trips	ROG	NOX	CO	PM10 ex	PM10 d	PM2.5 ex	PM2.5 d	SOx	CO2	CH4	N2O	CO2	CH4	N2O	CO2e	Fuel Gallons	Diesel PM (tons)
1-1	Demolition (Over-Water)	2025	22.7	20	2	909	45	3.38E-05	0.0021	0.0003	0.0000	0.0001	0.0000	0.0000	0.0000	1.6224	0.0000	0.0003	1.47	0.00	0.00	1.54	151	0.0000
1-2	Demolition (In-Water)	2025	22.7	20	2	909	45	3.38E-05	0.0021	0.0003	0.0000	0.0001	0.0000	0.0000	0.0000	1.6224	0.0000	0.0003	1.47	0.00	0.00	1.54	151	0.0000
1-3	Pier (In-Water)	2025	27.3	20	2	1091	55	4.06E-05	0.0025	0.0004	0.0000	0.0001	0.0000	0.0000	0.0000	1.9469	0.0000	0.0003	1.77	0.00	0.00	1.85	181	0.0000
1-4	Breakwater/Dolphin (In-Water)	2025	13.6	20	2	545	27	2.03E-05	0.0013	0.0002	0.0000	0.0001	0.0000	0.0000	0.0000	0.9734	0.0000	0.0002	0.88	0.00	0.00	0.92	90	0.0000
1-5	Pier (Over-Water)	2026	36.4	20	2	1455	73	5.33E-05	0.0033	0.0005	0.0000	0.0002	0.0000	0.0001	0.0000	2.5557	0.0000	0.0004	2.32	0.00	0.00	2.43	237	0.0000
1-6	Breakwater/Dolphin (Over-Water)	2026	27.3	20	2	1091	55	4.00E-05	0.0025	0.0004	0.0000	0.0001	0.0000	0.0000	0.0000	1.9168	0.0000	0.0003	1.74	0.00	0.00	1.82	178	0.0000
1-7	Small Boat Basin	2026	22.7	20	2	909	45	3.33E-05	0.0021	0.0003	0.0000	0.0001	0.0000	0.0000	0.0000	1.5973	0.0000	0.0003	1.45	0.00	0.00	1.52	148	0.0000
1-8	Marine Yard	2026	27.3	20	2	1091	55	4.00E-05	0.0025	0.0004	0.0000	0.0001	0.0000	0.0000	0.0000	1.9168	0.0000	0.0003	1.74	0.00	0.00	1.82	178	0.0000
1-8	Marine Yard	2026		20	2	0	0	0.00E+00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0.00	0	0.0000
1-8	Marine Yard	2026		20	2	0	0	0.00E+00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0.00	0	0.0000
2-1	Dredging	2027	25.0	20	2	1000	50	3.61E-05	0.0022	0.0004	0.0000	0.0001	0.0000	0.0000	0.0000	1.7273	0.0000	0.0003	1.57	0.00	0.00	1.64	160	0.0000
2-2	Dock / Breakwater (In-Water)	2027	43.8	20	2	1750	88	6.32E-05	0.0039	0.0006	0.0001	0.0002	0.0001	0.0001	0.0000	3.0228	0.0000	0.0005	2.74	0.00	0.00	2.87	281	0.0001
2-3	Dock / Breakwater (Over-Water)	2027	37.5	20	2	1500	75	5.42E-05	0.0033	0.0005	0.0000	0.0002	0.0000	0.0001	0.0000	2.5910	0.0000	0.0004	2.35	0.00	0.00	2.46	241	0.0000
2-4	Small Boat Basin #2	2027	43.8	20	2	1750	88	6.32E-05	0.0039	0.0006	0.0001	0.0002	0.0001	0.0001	0.0000	3.0228	0.0000	0.0005	2.74	0.00	0.00	2.87	281	0.0001
2-5	Marine/Naval Modulars	2027	50.0	20	2	2000	100	7.22E-05	0.0044	0.0007	0.0001	0.0003	0.0001	0.0001	0.0000	3.4546	0.0000	0.0005	3.13	0.00	0.00	3.28	321	0.0001
2-5	Marine/Naval Modulars	2027		20	2	0	0	0.00E+00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0.00	0	0.0000
2-5	Marine/Naval Modulars	2027		20	2	0	0	0.00E+00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0.00	0	0.0000
3-1	Dredging	2030	6.0	20	2	239	12	8.33E-06	0.0005	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.3911	0.0000	0.0001	0.35	0.00	0.00	0.37	36	0.0000
3-2	Breakwaters (In-Water)	2030	20.9	20	2	836	42	2.91E-05	0.0017	0.0003	0.0000	0.0001	0.0000	0.0000	0.0000	1.3689	0.0000	0.0002	1.24	0.00	0.00	1.30	127	0.0000
3-3	Observation Docks	2030	9.0	20	2	358	18	1.25E-05	0.0007	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.5867	0.0000	0.0001	0.53	0.00	0.00	0.56	55	0.0000
3-4	Row House (In-Water)	2030	6.0	20	2	239	12	8.33E-06	0.0005	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.3911	0.0000	0.0001	0.35	0.00	0.00	0.37	36	0.0000
3-5	Row House (Over-Water)	2030	23.9	20	2	955	48	3.33E-05	0.0020	0.0003	0.0000	0.0001	0.0000	0.0000	0.0000	1.5644	0.0000	0.0002	1.42	0.00	0.00	1.49	146	0.0000
3-6	Marine Yard Upgrades	2030	20.9	20	2	836	42	2.91E-05	0.0017	0.0003	0.0000	0.0001	0.0000	0.0000	0.0000	1.3689	0.0000	0.0002	1.24	0.00	0.00	1.30	127	0.0000
3-6	Marine Yard Upgrades	2030		20	2	0	0	0.00E+00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0.00	0	0.0000
3-6	Marine Yard Upgrades	2030		20	2	0	0	0.00E+00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0.00	0	0.0000
3-7	New Building	2031	98.5	20	2	3940	197	1.36E-04	0.0080	0.0014	0.0001	0.0005	0.0001	0.0002	0.0001	6.3469	0.0000	0.0010	5.76	0.00	0.00	6.03	590	0.0001
3-7	New Building	2031		20	2	0	0	0.00E+00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0.00	0	0.0000
3-7	New Building	2031		20	2	0	0	0.00E+00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.00	0.00	0	0.0000
3-8	Hydro Kinetic Barge (in-Water)	2032	9.0	20	2	358	18	1.23E-05	0.0007	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.5683	0.0000	0.0001	0.52	0.00	0.00	0.54	53	0.0000
3-9	Hydro Kinetic Barge (Over-Water)	2032	6.0	20	2	239	12	8.18E-06	0.0005	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.3789	0.0000	0.0001	0.34	0.00	0.00	0.36	35	0.0000

Worker Commute

Phase #	Construction Phase	Year	Working days	# Workers Per Day	Trips per worker	Average Trip Length (one way)	Daily VMT	Daily Trips	Total VMT	Total Trips
1-1	Demolition (Over-Water)	2025	170	50	2	11.7	1170	100	198,900	17,000
1-2	Demolition (In-Water)	2025								
1-3	Pier (In-Water)	2025								
1-4	Breakwater/Dolphin (In-Water)	2025								
1-5	Pier (Over-Water)	2026	303	50	2	11.7	1170	100	354,510	30,300
1-6	Breakwater/Dolphin (Over-Water)	2026								
1-7	Small Boat Basin	2026								
1-8	Marine Yard	2026								
2-1	Dredging	2027	312	50	2	11.7	1170	100	365,040	31,200
2-2	Dock / Breakwater (In-Water)	2027								
2-3	Dock / Breakwater (Over-Water)	2027								
2-4	Small Boat Basin #2	2027								
2-5	Marine/Naval Modulars	2027								
3-1	Dredging	2030	312	50	2	11.7	1170	100	365,040	31,200
3-2	Breakwaters (In-Water)	2030								
3-3	Observation Docks	2030								
3-4	Row House (In-Water)	2030								
3-5	Row House (Over-Water)	2030								
3-6	Marine Yard Upgrades	2030								
3-7	New Building	2031	312	50	2	11.7	1170	100	365,040	31,200
3-8	Hydro Kinetic Barge (In-Water)	2032	145	50	2	11.7	1170	100	169,650	14,500
3-9	Hydro Kinetic Barge (Over-Water)	2032								

Phase #	Emisssions (in tons per year)											Emissions (in MT per year)				
	ROG	NOX	CO	PM10 ex	PM10 d	PM2.5 ex	PM2.5 d	SOx	CO2	CH4	N2O	CO2	CH4	N2O	CO2e	Fuel Gallons
1-1	0.03	0.03	0.30	0.00	0.00	0.00	0.00	0.00	70.55	0.00	0.00	64.00	0.00	0.00	64.69	7495
1-2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0
1-3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0
1-4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0
1-5	0.06	0.04	0.49	0.00	0.01	0.00	0.00	0.00	122.99	0.00	0.00	111.57	0.00	0.00	112.72	13062
1-6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0
1-7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0
1-8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0
2-1	0.05	0.04	0.47	0.00	0.01	0.00	0.00	0.00	123.88	0.00	0.00	112.38	0.00	0.00	113.49	13152
2-2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0
2-3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0
2-4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0
2-5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0
3-1	0.05	0.03	0.39	0.00	0.01	0.00	0.00	0.00	116.27	0.00	0.00	105.48	0.00	0.00	106.43	12334
3-2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0
3-3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0
3-4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0
3-5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0
3-6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0
3-7	0.04	0.03	0.37	0.00	0.01	0.00	0.00	0.00	113.77	0.00	0.00	103.21	0.00	0.00	104.12	12066
3-8	0.02	0.01	0.16	0.00	0.00	0.00	0.00	0.00	51.90	0.00	0.00	47.08	0.00	0.00	47.48	5503
3-9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0

Concrete Truck Math 10 CY truck capacity
Filled in on 9/8/23 call with Rick and Russel

Phase 1		Phase 2	
For Pier and Trestle		**Pier**	
surface area			
30,000	ft2	13000	ft2
27		0.5	6 in topping slab
1111	yd2	6500	ft3
		240.7	CY
depth			
0.5	foot each	20	trucks
		over 3 days	
50	Trucks		
10 per day over a week			
Breakwater			
	pre-cast?		
	no concrete trips		
Dolphin			
250	ft2		
4	ft deep		
1000	ft3		
37	CY		
4	Trucks per		
4	mooring dolphins		
16	Total Trucks		
over a couple days			
Marine Yard			
800	ft2		
0.666667	8" deep		
533.3333	ft3		
20	CY		
2	trucks		
over 1 day			

7.5 minutes per yard https://wayne-companies.com/concrete-contractor-faq/
75 mins per truck

General Assumptions

lbs/gram	0.002204634	Standard	
kg/mt	1000	Standard	
mt/gram	0.000001	Standard	
mt/lbs	0.000453592	Standard	
ton/lbs	0.0005	Standard	
g to ton	1.10231E-06	Standard	
t to mt	0.907184741	Standard	
Gallons per acre-foot	325851	Standard	
MWh to mmBTU	3.41	Standard	
ton per cy conversion	1.2641662	CalEEMod	
ton per SF conversion	0.046	CalEEMod	
acre per SF conversion	2.29568E-05	Standard	
lbs CO2 per gallon of diesel	22.5091702	Climate Registry 2018	
lbs CO2 per gallon of gas	19.3565636	Climate Registry 2018	
HP to KW	0.7457		
MW/KW	0.001		
CH4 GWP	25	AR4	
N2O GWP	298	AR4	
Single trips per vehicle	2		
Employee one-way commute	11.7	miles/trip	caleemod default, worker, Solano (SF), MPO defaults
Vendor truck one-way trip dis	8.4	miles	caleemod default, vendor, Solano (SF), MPO defaults
Truck one-way trip distance o	20	miles	caleemod default, hauling
workers per day	50	all construction phases	
trucks per phase	200	running with first year EF to ensure conservative	

EMFAC Summary

		Running (RUNEX, PMTW, PMBW) grams per mile												Process (IDLEX, STREX, TOTEX, DIURN, HTSK, RUNLS, RESTL) grams per trip												Fuel		per mi	per trip
Type	Yr	ROG	TOG	CO	NOx	CO2	CH4	PM10 Ex	PM10 D	PM2.5 Ex	PM2.5 D	SOX	N2O	ROG	TOG	CO	NOx	CO2	CH4	PM10 Ex	PM10 D	PM2.5 Ex	PM2.5 D	SOX	N2O	gal/mi	mpg	DPM	DPM
Worker Commute	2025	0.0165	0.0240	0.9549	0.0869	314.8	0.0039	0.0015	0.0143	0.0013	0.0042	0.0031	0.0073	1.5625	1.6083	4.6373	0.3607	82.08	0.0976	0.0026	0.0000	0.0023	0.0000	0.0008	0.0385	0.0377	26.8645		
	2026	0.0147	0.0214	0.8875	0.0778	307.9	0.0035	0.0014	0.0143	0.0013	0.0042	0.0030	0.0067	1.4905	1.5333	4.3597	0.3416	80.12	0.0920	0.0025	0.0000	0.0023	0.0000	0.0008	0.0374	0.0368	27.4928		
	2027	0.0131	0.0191	0.8272	0.0698	301.2	0.0032	0.0013	0.0143	0.0012	0.0042	0.0030	0.0062	1.4280	1.4680	4.1030	0.3243	78.23	0.0869	0.0024	0.0000	0.0022	0.0000	0.0008	0.0364	0.0360	28.1323		
	2028	0.0117	0.0171	0.7753	0.0628	294.7	0.0029	0.0012	0.0143	0.0011	0.0042	0.0029	0.0058	1.3799	1.4173	3.8690	0.3085	76.43	0.0821	0.0022	0.0000	0.0021	0.0000	0.0008	0.0355	0.0352	28.7709		
	2029	0.0106	0.0154	0.7284	0.0566	288.6	0.0026	0.0012	0.0143	0.0011	0.0042	0.0029	0.0055	1.3167	1.3517	3.6469	0.2939	74.69	0.0776	0.0021	0.0000	0.0020	0.0000	0.0007	0.0346	0.0345	29.4066		
	2030	0.0095	0.0139	0.6872	0.0512	282.7	0.0024	0.0011	0.0143	0.0010	0.0042	0.0028	0.0051	1.2633	1.2961	3.4385	0.2803	73.02	0.0733	0.0020	0.0000	0.0019	0.0000	0.0007	0.0338	0.0338	30.0358		
	2031	0.0085	0.0125	0.6528	0.0460	276.6	0.0022	0.0010	0.0144	0.0009	0.0043	0.0027	0.0048	1.2037	1.2342	3.2311	0.2671	71.40	0.0691	0.0019	0.0000	0.0017	0.0000	0.0007	0.0330	0.0331	30.7085		
	2032	0.0077	0.0113	0.6201	0.0417	271.5	0.0020	0.0010	0.0144	0.0009	0.0042	0.0027	0.0046	1.1492	1.1778	3.0492	0.2556	69.91	0.0654	0.0018	0.0000	0.0016	0.0000	0.0007	0.0324	0.0324	31.2990		
	2033	0.0070	0.0102	0.5909	0.0380	266.8	0.0019	0.0009	0.0144	0.0008	0.0042	0.0026	0.0044	1.1126	1.1393	2.8781	0.2450	68.50	0.0618	0.0017	0.0000	0.0015	0.0000	0.0007	0.0317	0.0319	31.8624		
	2034	0.0063	0.0092	0.5638	0.0348	262.5	0.0017	0.0008	0.0144	0.0008	0.0042	0.0026	0.0042	1.0546	1.0794	2.7102	0.2355	67.16	0.0584	0.0016	0.0000	0.0014	0.0000	0.0007	0.0311	0.0313	32.3972		
	2035	0.0057	0.0084	0.5411	0.0323	258.5	0.0016	0.0008	0.0144	0.0007	0.0042	0.0026	0.0040	1.0456	1.0688	2.5658	0.2276	65.95	0.0553	0.0015	0.0000	0.0014	0.0000	0.0007	0.0306	0.0309	32.8955		
Trucks	2025	0.0159	0.0181	0.0760	1.7583	1577.7	0.0007	0.0275	0.1133	0.0263	0.0361	0.0149	0.2486	0.3582	0.4077	5.2353	7.1487	826.90	0.0166	0.0020	0.0000	0.0019	0.0000	0.0078	0.1303	0.1656	6.0381	0.0275	0.0020
	2026	0.0154	0.0175	0.0721	1.7042	1553.5	0.0007	0.0274	0.1136	0.0262	0.0362	0.0147	0.2447	0.3570	0.4065	5.2252	7.0751	810.16	0.0166	0.0019	0.0000	0.0018	0.0000	0.0077	0.1276	0.1631	6.1296	0.0274	0.0019
	2027	0.0149	0.0170	0.0687	1.6542	1527.3	0.0007	0.0272	0.1142	0.0260	0.0364	0.0145	0.2406	0.3562	0.4055	5.2189	6.9876	794.46	0.0165	0.0019	0.0000	0.0018	0.0000	0.0075	0.1252	0.1605	6.2319	0.0272	0.0019
	2028	0.0145	0.0165	0.0656	1.6064	1499.7	0.0007	0.0271	0.1147	0.0259	0.0366	0.0142	0.2363	0.3557	0.4049	5.2161	6.8882	779.34	0.0165	0.0018	0.0000	0.0018	0.0000	0.0074	0.1228	0.1576	6.3436	0.0271	0.0018
	2029	0.0142	0.0161	0.0629	1.5661	1473.3	0.0007	0.0270	0.1152	0.0258	0.0368	0.0140	0.2321	0.3554	0.4045	5.2159	6.7926	765.48	0.0165	0.0018	0.0000	0.0017	0.0000	0.0072	0.1206	0.1549	6.4551	0.0270	0.0018
	2030	0.0139	0.0158	0.0605	1.5320	1448.1	0.0006	0.0269	0.1157	0.0257	0.0370	0.0137	0.2281	0.3552	0.4044	5.2179	6.7181	752.91	0.0165	0.0017	0.0000	0.0017	0.0000	0.0071	0.1186	0.1523	6.5650	0.0269	0.0017
	2031	0.0136	0.0154	0.0585	1.5028	1424.2	0.0006	0.0268	0.1162	0.0256	0.0371	0.0135	0.2244	0.3553	0.4045	5.2234	6.6601	741.88	0.0165	0.0017	0.0000	0.0016	0.0000	0.0070	0.1169	0.1498	6.6743	0.0268	0.0017
	2032	0.0133	0.0151	0.0568	1.4779	1402.6	0.0006	0.0267	0.1167	0.0256	0.0373	0.0133	0.2210	0.3555	0.4047	5.2294	6.6085	732.13	0.0165	0.0017	0.0000	0.0016	0.0000	0.0069	0.1153	0.1476	6.7760	0.0267	0.0017
	2033	0.0130	0.0148	0.0553	1.4534	1383.4	0.0006	0.0266	0.1172	0.0255	0.0375	0.0131	0.2180	0.3558	0.4050	5.2373	6.5627	723.71	0.0165	0.0017	0.0000	0.0016	0.0000	0.0069	0.1140	0.1456	6.8692	0.0266	0.0017
	2034	0.0127	0.0145	0.0538	1.4269	1366.1	0.0006	0.0265	0.1176	0.0254	0.0376	0.0129	0.2152	0.3563	0.4056	5.2479	6.5201	716.61	0.0165	0.0016	0.0000	0.0016	0.0000	0.0068	0.1129	0.1438	6.9558	0.0265	0.0016
	2035	0.0124	0.0142	0.0525	1.4051	1351.5	0.0006	0.0264	0.1180	0.0253	0.0377	0.0128	0.2129	0.3569	0.4063	5.2592	6.4810	710.79	0.0166	0.0016	0.0000	0.0015	0.0000	0.0067	0.1120	0.1422	7.0308	0.0264	0.0016

Fugitive Dust Emission Factors

Daily Paved Road Dust EF[1]

$$E_{ext} = [\ k\ (sL)^{0.91} \times (W)^{1.02}\ ]$$

EF_{paved}	Annual or other long-term average emission factor in the same units as k
k	particle size multiplier for particle size range and units of interest
sL	road surface silt loading (g/m^2)
W	average weight (tons) of all the vehicles raveling the road (2.4 tons)
P	Number of "wet' days with at least 0.254 (0.01 in) of precipitation during the averaging period
N	Number of days in the averaging period (e.g. 365 for annual, 91 for seasonal, 30 for monthly)

Parameters	**PM10**	**PM2.5**
k (lb/VMT)[2]	0.0022	0.00054
sL (g/m^2)	0.1	0.1
W (tons)	2.4	2.4
EF (lb/mi)	6.61E-04	1.62E-04
EF (g/mi)	0.30	0.07

1) CalEEMod User's Guide, Appendix A, p. 29

2) AP42: Chapter 13: Miscellaneous Sources, 13.2.1 Paved Roads, Table 13.2.1-1

Harbor Craft Calculations

Summary - Harbor Craft Emissions

		Total Tons					Working	Average Lbs Per Day					
		ROG	NOX	CO	PM10 ex	PM2.5 ex	Days	ROG	NOX	CO	PM10 ex	PM2.5 ex	
Phase 1	2025	0.094	2.936	0.622	0.059	0.057	170	1.11	34.54	7.32	0.70	0.67	1
	2026	0.094	2.936	0.62	0.06	0.06	303	0.62	19.38	4.11	0.39	0.37	1
Phase 2	2027	0.119	3.708	0.786	0.075	0.072	312	0.76	23.77	5.04	0.48	0.46	2
Phase 3	2030	0.109	3.399	0.721	0.069	0.066	312	0.70	21.79	4.62	0.44	0.42	3
	2031	0.000	0.00	0.00	0.00	0.00	312	0.00	0.00	0.00	0.00	0.00	3
	2032	0.016	0.49	0.11	0.01	0.01	145	0.22	6.78	1.45	0.14	0.13	3

GHG		Total MT
		CO2e
Phase 1	2025	393
	2026	393
Phase 2	2027	496
Phase 3	2030	455
	2031	0
	2032	66
	Total	1804

Gallons		
		Diesel
Total		174339

Emissions Summary by Phase, Element, and Year

	Avg Daily Lbs								
	ROG	CO	NO_x	PM10	PM2.5	SO_2	CO_2	Ch4	N2O
Phase One	2.1	12.7	65.0	1.2	1.2	0.0	9,220.3	0.1	0.4
Phase Two	2.6	16.5	84.6	1.6	1.5	0.0	12,010.7	0.1	0.5
Phase Three	1.3	8.1	41.3	0.8	0.7	0.0	5,865.3	0.0	0.3

	Emisssions (in total tons)								Working			Average Lbs per day								MT
	ROG	NOX	CO	PM10 ex	PM10 d	PM2.5 ex	PM2.5 d	SOx	Days	Phase	Year	ROG	NOX	CO	PM10 ex	PM10 d	PM2.5 ex	PM2.5 d	SOx	CO2e
1-1_2025	0.025	0.773	0.164	0.016	0.000	0.015	0.000	0.000	60	1	2025	0.825	25.752	5.460	0.521		0.498		0.000	103.43
1-2_2025	0.025	0.773	0.164	0.016	0.000	0.015	0.000	0.000	60	1	2025	0.825	25.752	5.460	0.521		0.498		0.000	103.43
1-3_2025	0.030	0.927	0.197	0.019	0.000	0.018	0.000	0.000	72	1	2025	0.825	25.752	5.460	0.521		0.498		0.000	124.11
1-4_2025	0.015	0.464	0.098	0.009	0.000	0.009	0.000	0.000	36	1	2025	0.825	25.752	5.460	0.521		0.498		0.000	62.06
1-5_2026	0.040	1.236	0.262	0.025	0.000	0.024	0.000	0.000	96	1	2026	0.825	25.752	5.460	0.521		0.498		0.000	165.49
1-6_2026	0.030	0.927	0.197	0.019	0.000	0.018	0.000	0.000	72	1	2026	0.825	25.752	5.460	0.521		0.498		0.000	124.11
1-7_2026	0.025	0.773	0.164	0.016	0.000	0.015	0.000	0.000	60	1	2026	0.825	25.752	5.460	0.521		0.498		0.000	103.43
1-8_2026	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0	1	2026									0.00
2-1_2027	0.020	0.618	0.131	0.012	0.000	0.012	0.000	0.000	48	2	2027	0.825	25.752	5.460	0.521		0.498		0.000	82.74
2-2_2027	0.035	1.082	0.229	0.022	0.000	0.021	0.000	0.000	84	2	2027	0.825	25.752	5.460	0.521		0.498		0.000	144.80
2-3_2027	0.030	0.927	0.197	0.019	0.000	0.018	0.000	0.000	72	2	2027	0.825	25.752	5.460	0.521		0.498		0.000	124.11
2-4_2027	0.035	1.082	0.229	0.022	0.000	0.021	0.000	0.000	84	2	2027	0.825	25.752	5.460	0.521		0.498		0.000	144.80
2-5_2027	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0	2	2027									0.00
3-1_2030	0.010	0.309	0.066	0.006	0.000	0.006	0.000	0.000	24	3	2030	0.825	25.752	5.460	0.521		0.498		0.000	41.37
3-2_2030	0.035	1.082	0.229	0.022	0.000	0.021	0.000	0.000	84	3	2030	0.825	25.752	5.460	0.521		0.498		0.000	144.80
3-3_2030	0.015	0.464	0.098	0.009	0.000	0.009	0.000	0.000	36	3	2030	0.825	25.752	5.460	0.521		0.498		0.000	62.06
3-4_2030	0.010	0.309	0.066	0.006	0.000	0.006	0.000	0.000	24	3	2030	0.825	25.752	5.460	0.521		0.498		0.000	41.37
3-5_2030	0.040	1.236	0.262	0.025	0.000	0.024	0.000	0.000	96	3	2030	0.825	25.752	5.460	0.521		0.498		0.000	165.49
3-6_2030	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0	3	2030									0.00
3-6_2031	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0	3	2031									0.00
3-7_2031	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0	3	2031									0.00
3-7_2032	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0	3	2032									0.00
3-8_2032	0.015	0.464	0.098	0.009	0.000	0.009	0.000	0.000	36	3	2032	0.825	25.752	5.460	0.521		0.498		0.000	62.06
3-9_2032	0.001	0.028	0.007	0.001	0.000	0.001	0.000	0.000	24	3	2032	0.075	2.315	0.599	0.057		0.055		0.000	3.98

HARBOR CRAFT EMISSION CALCULATIONS

				Equipment Specs						Total Emisssions (in tons)							Emissions (in MT)				
Phase	Activity	Year	Working days	Equipment	OFFROAD Match	#	Hrs/day	Daily Hours	Total Hours	ROG	NOX	CO	PM10 ex	PM10 d	PM2.5 ex	PM2.5 d	CO2	CH4	N2O	CO2e	Fuel Gallons
1-1	Demolition (Over-Water)	2025	60	Derrick Barge w/ Crane	Barge-Other	1	8	8	480	0.01	0.28	0.1	0.0	0.0	0.01	0.0	39.2	0.0	0.0	39.8	3844
1-1	Demolition (Over-Water)	2025	60	Workboats	Workboat	1	2	2	120	0.00	0.15	0.0	0.0	0.0	0.00	0.0	19.6	0.0	0.0	19.8	1915
1-1	Demolition (Over-Water)	2025	60	Flat Deck Barge	Barge-Other	1	2	2	120	0.00	0.07	0.0	0.0	0.0	0.00	0.0	9.8	0.0	0.0	9.9	961
1-1	Demolition (Over-Water)	2025	60	Tugboat	Tugboat-Push/Tow	1	2	2	120	0.01	0.27	0.0	0.0	0.0	0.00	0.0	33.5	0.0	0.0	33.9	3277
1-2	Demolition (In-Water)	2025	60	Derrick Barge w/ Crane	Barge-Other	1	8	8	480	0.01	0.28	0.1	0.0	0.0	0.01	0.0	39.2	0.0	0.0	39.8	3844
1-2	Demolition (In-Water)	2025	60	Workboats	Workboat	1	2	2	120	0.00	0.15	0.0	0.0	0.0	0.00	0.0	19.6	0.0	0.0	19.8	1915
1-2	Demolition (In-Water)	2025	60	Flat Deck Barge	Barge-Other	1	2	2	120	0.00	0.07	0.0	0.0	0.0	0.00	0.0	9.8	0.0	0.0	9.9	961
1-2	Demolition (In-Water)	2025	60	Tugboat	Tugboat-Push/Tow	1	2	2	120	0.01	0.27	0.0	0.0	0.0	0.00	0.0	33.5	0.0	0.0	33.9	3277
1-3	Pier (In-Water)	2025	72	Derrick Barge w/ Crane	Barge-Other	1	8	8	576	0.01	0.33	0.1	0.0	0.0	0.01	0.0	47.1	0.0	0.0	47.7	4613
1-3	Pier (In-Water)	2025	72	Workboats	Workboat	1	2	2	144	0.01	0.19	0.0	0.0	0.0	0.00	0.0	23.5	0.0	0.0	23.8	2298
1-3	Pier (In-Water)	2025	72	Flat Deck Barge	Barge-Other	1	2	2	144	0.00	0.08	0.0	0.0	0.0	0.00	0.0	11.8	0.0	0.0	11.9	1153
1-3	Pier (In-Water)	2025	72	Tugboat	Tugboat-Push/Tow	1	2	2	144	0.01	0.32	0.1	0.0	0.0	0.01	0.0	40.2	0.0	0.0	40.7	3933
1-4	Breakwater/Dolphin (In-Water)	2025	36	Derrick Barge w/ Crane	Barge-Other	1	8	8	288	0.01	0.17	0.0	0.0	0.0	0.00	0.0	23.5	0.0	0.0	23.9	2306
1-4	Breakwater/Dolphin (In-Water)	2025	36	Workboats	Workboat	1	2	2	72	0.00	0.09	0.0	0.0	0.0	0.00	0.0	11.7	0.0	0.0	11.9	1149
1-4	Breakwater/Dolphin (In-Water)	2025	36	Flat Deck Barge	Barge-Other	1	2	2	72	0.00	0.04	0.0	0.0	0.0	0.00	0.0	5.9	0.0	0.0	6.0	577
1-4	Breakwater/Dolphin (In-Water)	2025	36	Tugboat	Tugboat-Push/Tow	1	2	2	72	0.01	0.16	0.0	0.0	0.0	0.00	0.0	20.1	0.0	0.0	20.3	1966
1-5	Pier (Over-Water)	2026	96	Derrick Barge w/ Crane	Barge-Other	1	8	8	768	0.01	0.44	0.1	0.0	0.0	0.01	0.0	62.8	0.0	0.0	63.6	6150
1-5	Pier (Over-Water)	2026	96	Workboats	Workboat	1	2	2	192	0.01	0.25	0.0	0.0	0.0	0.00	0.0	31.3	0.0	0.0	31.7	3064
1-5	Pier (Over-Water)	2026	96	Sectional Barges	Barge-Other	1	2	2	192	0.00	0.11	0.0	0.0	0.0	0.00	0.0	15.7	0.0	0.0	15.9	1538
1-5	Pier (Over-Water)	2026	96	Tugboat	Tugboat-Push/Tow	1	2	2	192	0.01	0.43	0.1	0.0	0.0	0.01	0.0	53.5	0.0	0.0	54.3	5244
1-6	Breakwater/Dolphin (Over-Water)	2026	72	Derrick Barge w/ Crane	Barge-Other	1	8	8	576	0.01	0.33	0.1	0.0	0.0	0.01	0.0	47.1	0.0	0.0	47.7	4613
1-6	Breakwater/Dolphin (Over-Water)	2026	72	Workboats	Workboat	1	2	2	144	0.01	0.19	0.0	0.0	0.0	0.00	0.0	23.5	0.0	0.0	23.8	2298
1-6	Breakwater/Dolphin (Over-Water)	2026	72	Sectional Barges	Barge-Other	1	2	2	144	0.00	0.08	0.0	0.0	0.0	0.00	0.0	11.8	0.0	0.0	11.9	1153
1-6	Breakwater/Dolphin (Over-Water)	2026	72	Tugboat	Tugboat-Push/Tow	1	2	2	144	0.01	0.32	0.1	0.0	0.0	0.01	0.0	40.2	0.0	0.0	40.7	3933
1-7	Small Boat Basin	2026	60	Derrick Barge w/ Crane	Barge-Other	1	8	8	480	0.01	0.28	0.1	0.0	0.0	0.01	0.0	39.2	0.0	0.0	39.8	3844
1-7	Small Boat Basin	2026	60	Workboats	Workboat	1	2	2	120	0.00	0.15	0.0	0.0	0.0	0.00	0.0	19.6	0.0	0.0	19.8	1915
1-7	Small Boat Basin	2026	60	Flat Deck Barge	Barge-Other	1	2	2	120	0.00	0.07	0.0	0.0	0.0	0.00	0.0	9.8	0.0	0.0	9.9	961
1-7	Small Boat Basin	2026	60	Tugboat	Tugboat-Push/Tow	1	2	2	120	0.01	0.27	0.0	0.0	0.0	0.00	0.0	33.5	0.0	0.0	33.9	3277
2-1	Dredging	2027	48	Derrick Barge w/ Crane	Barge-Other	1	8	8	384	0.01	0.22	0.1	0.0	0.0	0.01	0.0	31.4	0.0	0.0	31.8	3075
2-1	Dredging	2027	48	Workboats	Workboat	1	2	2	96	0.00	0.12	0.0	0.0	0.0	0.00	0.0	15.6	0.0	0.0	15.9	1532
2-1	Dredging	2027	48	Flat Deck Barge	Barge-Other	1	2	2	96	0.00	0.06	0.0	0.0	0.0	0.00	0.0	7.8	0.0	0.0	8.0	769
2-1	Dredging	2027	48	Tugboat	Tugboat-Push/Tow	1	2	2	96	0.01	0.22	0.0	0.0	0.0	0.00	0.0	26.8	0.0	0.0	27.1	2622
2-2	Dock / Breakwater (In-Water)	2027	84	Derrick Barge w/ Crane	Barge-Other	1	8	8	672	0.01	0.39	0.1	0.0	0.0	0.01	0.0	54.9	0.0	0.0	55.7	5381
2-2	Dock / Breakwater (In-Water)	2027	84	Workboats	Workboat	1	2	2	168	0.01	0.22	0.0	0.0	0.0	0.00	0.0	27.4	0.0	0.0	27.7	2681
2-2	Dock / Breakwater (In-Water)	2027	84	Flat Deck Barge	Barge-Other	1	2	2	168	0.00	0.10	0.0	0.0	0.0	0.00	0.0	13.7	0.0	0.0	13.9	1345
2-2	Dock / Breakwater (In-Water)	2027	84	Tugboat	Tugboat-Push/Tow	1	2	2	168	0.01	0.38	0.1	0.0	0.0	0.01	0.0	46.8	0.0	0.0	47.5	4588
2-3	Dock / Breakwater (Over-Water)	2027	72	Derrick Barge w/ Crane	Barge-Other	1	8	8	576	0.01	0.33	0.1	0.0	0.0	0.01	0.0	47.1	0.0	0.0	47.7	4613
2-3	Dock / Breakwater (Over-Water)	2027	72	Workboats	Workboat	1	2	2	144	0.01	0.19	0.0	0.0	0.0	0.00	0.0	23.5	0.0	0.0	23.8	2298
2-3	Dock / Breakwater (Over-Water)	2027	72	Sectional Barges	Barge-Other	1	2	2	144	0.00	0.08	0.0	0.0	0.0	0.00	0.0	11.8	0.0	0.0	11.9	1153
2-3	Dock / Breakwater (Over-Water)	2027	72	Tugboat	Tugboat-Push/Tow	1	2	2	144	0.01	0.32	0.1	0.0	0.0	0.01	0.0	40.2	0.0	0.0	40.7	3933
2-4	Small Boat Basin #2	2027	84	Derrick Barge w/ Crane	Barge-Other	1	8	8	672	0.01	0.39	0.1	0.0	0.0	0.01	0.0	54.9	0.0	0.0	55.7	5381
2-4	Small Boat Basin #2	2027	84	Workboats	Workboat	1	2	2	168	0.01	0.22	0.0	0.0	0.0	0.00	0.0	27.4	0.0	0.0	27.7	2681
2-4	Small Boat Basin #2	2027	84	Flat Deck Barge	Barge-Other	1	2	2	168	0.00	0.10	0.0	0.0	0.0	0.00	0.0	13.7	0.0	0.0	13.9	1345
2-4	Small Boat Basin #2	2027	84	Tugboat	Tugboat-Push/Tow	1	2	2	168	0.01	0.38	0.1	0.0	0.0	0.01	0.0	46.8	0.0	0.0	47.5	4588

HARBOR CRAFT EMISSION CALCULATIONS

				Equipment Specs						Total Emisssions (in tons)							Emissions (in MT)				
Phase	Activity	Year	Working days	Equipment	OFFROAD Match	#	Hrs/day	Daily Hours	Total Hours	ROG	NOX	CO	PM10 ex	PM10 d	PM2.5 ex	PM2.5 d	CO2	CH4	N2O	CO2e	Fuel Gallons
3-1	Dredging	2030	24	Derrick Barge w/ Crane	Barge-Other	1	8	8	192	0.0	0.11	0.0	0.0	0.0	0.0	0.0	15.7	0.0	0.0	15.9	1538
3-1	Dredging	2030	24	Workboats	Workboat	1	2	2	48	0.0	0.06	0.0	0.0	0.0	0.0	0.0	7.8	0.0	0.0	7.9	766
3-1	Dredging	2030	24	Flat Deck Barge	Barge-Other	1	2	2	48	0.0	0.03	0.0	0.0	0.0	0.0	0.0	3.9	0.0	0.0	4.0	384
3-1	Dredging	2030	24	Tugboat	Tugboat-Push/Tow	1	2	2	48	0.0	0.11	0.0	0.0	0.0	0.0	0.0	13.4	0.0	0.0	13.6	1311
3-2	Breakwaters (In-Water)	2030	84	Derrick Barge w/ Crane	Barge-Other	1	8	8	672	0.0	0.39	0.1	0.0	0.0	0.0	0.0	54.9	0.0	0.0	55.7	5381
3-2	Breakwaters (In-Water)	2030	84	Workboats	Workboat	1	2	2	168	0.0	0.22	0.0	0.0	0.0	0.0	0.0	27.4	0.0	0.0	27.7	2681
3-2	Breakwaters (In-Water)	2030	84	Flat Deck Barge	Barge-Other	1	2	2	168	0.0	0.10	0.0	0.0	0.0	0.0	0.0	13.7	0.0	0.0	13.9	1345
3-2	Breakwaters (In-Water)	2030	84	Tugboat	Tugboat-Push/Tow	1	2	2	168	0.0	0.38	0.1	0.0	0.0	0.0	0.0	46.8	0.0	0.0	47.5	4588
3-3	Observation Docks	2030	36	Derrick Barge w/ Crane	Barge-Other	1	8	8	288	0.0	0.17	0.0	0.0	0.0	0.0	0.0	23.5	0.0	0.0	23.9	2306
3-3	Observation Docks	2030	36	Workboats	Workboat	1	2	2	72	0.0	0.09	0.0	0.0	0.0	0.0	0.0	11.7	0.0	0.0	11.9	1149
3-3	Observation Docks	2030	36	Flat Deck Barge	Barge-Other	1	2	2	72	0.0	0.04	0.0	0.0	0.0	0.0	0.0	5.9	0.0	0.0	6.0	577
3-3	Observation Docks	2030	36	Tugboat	Tugboat-Push/Tow	1	2	2	72	0.0	0.16	0.0	0.0	0.0	0.0	0.0	20.1	0.0	0.0	20.3	1966
3-4	Row House (In-Water)	2030	24	Derrick Barge w/ Crane	Barge-Other	1	8	8	192	0.0	0.11	0.0	0.0	0.0	0.0	0.0	15.7	0.0	0.0	15.9	1538
3-4	Row House (In-Water)	2030	24	Workboats	Workboat	1	2	2	48	0.0	0.06	0.0	0.0	0.0	0.0	0.0	7.8	0.0	0.0	7.9	766
3-4	Row House (In-Water)	2030	24	Sectional Barges	Barge-Other	1	2	2	48	0.0	0.03	0.0	0.0	0.0	0.0	0.0	3.9	0.0	0.0	4.0	384
3-4	Row House (In-Water)	2030	24	Tugboat	Tugboat-Push/Tow	1	2	2	48	0.0	0.11	0.0	0.0	0.0	0.0	0.0	13.4	0.0	0.0	13.6	1311
3-5	Row House (Over-Water)	2030	96	Derrick Barge w/ Crane	Barge-Other	1	8	8	768	0.0	0.44	0.1	0.0	0.0	0.0	0.0	62.8	0.0	0.0	63.6	6150
3-5	Row House (Over-Water)	2030	96	Workboats	Workboat	1	2	2	192	0.0	0.25	0.0	0.0	0.0	0.0	0.0	31.3	0.0	0.0	31.7	3064
3-5	Row House (Over-Water)	2030	96	Sectional Barges	Barge-Other	1	2	2	192	0.0	0.11	0.0	0.0	0.0	0.0	0.0	15.7	0.0	0.0	15.9	1538
3-5	Row House (Over-Water)	2030	96	Tugboat	Tugboat-Push/Tow	1	2	2	192	0.0	0.43	0.1	0.0	0.0	0.0	0.0	53.5	0.0	0.0	54.3	5244
3-8	Hydro Kinetic Barge (in-Water)	2032	36	Derrick Barge w/ Crane	Barge-Other	1	8	8	288	0.0	0.17	0.0	0.0	0.0	0.0	0.0	23.5	0.0	0.0	23.9	2306
3-8	Hydro Kinetic Barge (in-Water)	2032	36	Workboats	Workboat	1	2	2	72	0.0	0.09	0.0	0.0	0.0	0.0	0.0	11.7	0.0	0.0	11.9	1149
3-8	Hydro Kinetic Barge (in-Water)	2032	36	Flat Deck Barge	Barge-Other	1	2	2	72	0.0	0.04	0.0	0.0	0.0	0.0	0.0	5.9	0.0	0.0	6.0	577
3-8	Hydro Kinetic Barge (in-Water)	2032	36	Tugboat	Tugboat-Push/Tow	1	2	2	72	0.0	0.16	0.0	0.0	0.0	0.0	0.0	20.1	0.0	0.0	20.3	1966
3-9	Hydro Kinetic Barge (Over-Water)	2032	24	Flat Deck Barge	Barge-Other	1	2	2	48	0.0	0.03	0.0	0.0	0.0	0.0	0.0	3.9	0.0	0.0	4.0	384

HARBOR CRAFT EMISSION FACTOR CALCULATIONS

2025 8 11 7 5 10 4

CARB Defaults

Emission Factor Data

Equipment	CARB Type	Main Engines MY	Main Engines No	Main Engines HP Each	Auxiliary Engines MY	Auxiliary Engines No	Auxiliary Engines HP Each	HP Bin Main (1)	HP Bin Aux (2)	Tier	Main ZH EF CO	Main ZH EF HC	Main ZH EF NOx	Main ZH EF PM	Aux ZH EF CO	Aux ZH EF HC	Aux ZH EF NOx	Aux ZH EF PM
Derrick Barge w/ Crane	Barge-Other	-	-	-	2002	2.2	224	-	300	3	0	0	0	0	0.779	0.118	3.222	0.073
Workboats	Workboat	2000	1.6	471	1998	0.7	247	600	300	3	0.5634213	0.132067668	3.727711	0.05128	0.779	0.118	3.222	0.073
Flat Deck Barge	Barge-Other	-	-	-	2002	2.2	224	-	300	3	0	0	0	0	0.779	0.118	3.222	0.073
Tugboat	Tugboat-Push/Tow	2002	2.0	731	2003	1.5	93	800	100	3	0.5634213	0.132067668	3.727711	0.05128	0.820	0.149	3.748	0.116
Sectional Barges	Barge-Other	-	-	-	2002	2.2	224	-	300	3	0	0	0	0	0.779	0.118	3.222	0.073

Equipment	Model Year Assumed Main	Model Year Assumed Aux	Det Rate row lookup Main	Det Rate row lookup Aux	Main CO	Main HC	Main NOx	Main PM	Aux CO	Aux HC	Aux NOx	Aux PM
Derrick Barge w/ Crane	-	2013		3	-	-	-	-	0.16	0.28	0.14	0.44
Workboats	2013	2013	4	3	0.25	0.44	0.21	0.67	0.16	0.28	0.14	0.44
Flat Deck Barge	-	2013		3	-	-	-	-	0.16	0.28	0.14	0.44
Tugboat	2013	2009	4	2	0.25	0.44	0.21	0.67	0.41	0.51	0.06	0.31
Sectional Barges	-	2013		3	-	-	-	-	0.16	0.28	0.14	0.44

Equipment	CARB Type	Fuel Correction row lookup All	CO	HC	NOx	PM	Useful Life (yrs) Main	Aux	Avg hours on engine per yr Main	Aux	Age (in years) Main	Aux	)00 hr Age (yrs) 12000 r Main	Aux
Derrick Barge w/ Crane	Barge-Other	4	1	0.72	0.948	0.852	25	14	-	1031	-	12	-	12,000
Workboats	Workboat	4	1	0.72	0.948	0.852	22	28	639	717	12	12	7,668	8,604
Flat Deck Barge	Barge-Other	4	1	0.72	0.948	0.852	25	14	-	1031	-	12	-	12,000
Tugboat	Tugboat-Push/Tow	4	1	0.72	0.948	0.852	14	16	1550	1822	12	16	12,000	12,000
Sectional Barges	Barge-Other	4	1	0.72	0.948	0.852	25	14	-	1031	-	12	-	12,000

In Use EF Calculation

In-Use Rate (g/hp-hr)

Equipment	CARB Type	Main CO	Main HC	Main NOx	Main PM	Aux CO	Aux HC	Aux NOx	Aux PM
Derrick Barge w/ Crane	Barge-Other					0.882115	0.104571	3.410189	0.084479
Workboats	Workboat	0.640251	0.117910014	3.938659	0.059658	0.831939	0.095004	3.237931	0.073517
Flat Deck Barge	Barge-Other					0.882115	0.104571	3.410189	0.084479
Tugboat	Tugboat-Push/Tow	0.641314	0.118225516	3.944255	0.059878	0.958634	0.129444	3.640786	0.111158
Sectional Barges	Barge-Other					0.882115	0.104571	3.410189	0.084479

Equipment	Main ROG	Main CO	Main NO_x	Main PM10	Main PM2.5	Main SO_2	Main CO_2	Main Ch4	Main N2O	Aux ROG	Aux CO	Aux NO_x	Aux PM10	Aux PM2.5	Aux SO_2	Aux CO_2	Aux Ch4	Aux N2O
Derrick Barge w/ Crane										0.110113	0.882115	3.410188571	0.0844788	0.080762		531	0.00312	0.023404
Workboats	0.124159	0.6402515	3.938658887	0.059658	0.057033		531	0.00312	0.023404	0.100039	0.831939	3.237931088	0.0735166	0.070282		531	0.00312	0.023404
Flat Deck Barge										0.110113	0.882115	3.410188571	0.0844788	0.080762		531	0.00312	0.023404
Tugboat	0.124491	0.6413136	3.944255045	0.059878	0.057244		531	0.00312	0.023404	0.136304	0.958634	3.64078588	0.1111578	0.106267		554	0.003256	0.024417
Sectional Barges										0.110113	0.882115	3.410188571	0.0844788	0.080762		531	0.00312	0.023404

Emission Calculations

Main Engine

Equipment	CARB Type	Main HP each	Main No	LF	Pounds Per Hour ROG	CO	NO_x	PM10	PM2.5	SO_2	CO_2	Ch4	N2O
Derrick Barge w/ Crane	Barge-Other	-	-										
Workboats	Workboat	471	1.6	0.33	0.068	0.352	2.163	0.033	0.031	0.000	291.664	0.002	0.013
Flat Deck Barge	Barge-Other	-	-										
Tugboat	Tugboat-Push/Tow	731	2.0	0.33	0.129	0.666	4.098	0.062	0.059	0.000	551.723	0.003	0.024
Sectional Barges	Barge-Other	-	-										

Aux Engines

Equipment	CARB Type	Aux HP each	Aux No	LF	Pounds Per Hour ROG	CO	NO_x	PM10	PM2.5	SO_2	CO_2	Ch4	N2O
Derrick Barge w/ Crane	Barge-Other	224	2.2	0.31	0.037	0.299	1.158	0.029	0.027	0.000	180.253	0.001	0.008
Workboats	Workboat	247	0.7	0.32	0.013	0.106	0.412	0.009	0.009	0.000	67.582	0.000	0.003
Flat Deck Barge	Barge-Other	224	2.2	0.31	0.037	0.299	1.158	0.029	0.027	0.000	180.253	0.001	0.008
Tugboat	Tugboat-Push/Tow	93	1.5	0.37	0.016	0.109	0.414	0.013	0.012	0.000	63.041	0.000	0.003
Sectional Barges	Barge-Other	224	2.2	0.31	0.037	0.299	1.158	0.029	0.027	0.000	180.253	0.001	0.008

Combined

	Pounds Per Hour ROG	CO	NO_x	PM10	PM2.5	SO_2	CO_2	Ch4	N2O	ME % of total	AE % of total
Derrick Barge w/ Crane	0.037	0.299	1.158	0.029	0.027	0.000	180.253	0.001	0.008	100%	0%
Workboats	0.081	0.458	2.576	0.042	0.040	0.000	359.247	0.002	0.016	16%	84%
Flat Deck Barge	0.037	0.299	1.158	0.029	0.027	0.000	180.253	0.001	0.008	100%	0%
Tugboat	0.145	0.775	4.512	0.075	0.072	0.000	614.764	0.004	0.027	9%	91%
Sectional Barges	0.037	0.299	1.158	0.029	0.027	0.000	180.253	0.001	0.008	100%	0%
1	2	3	4	5	6	7	8	9	10		

Method:

$EF = EF0(1 + DF \times Age/UL)$ * FCF too for the sake of the EF

Where:

EF0: zero-hour emission factor, when engine is new or rebuilt (g/bhp-hr);

DF: the horsepower and pollutant specific engine deterioration factor, which is the percentage increase of emission factors at the end of the useful life of the engine;

Age: the age of the engine when the emissions are estimated; and

UL: the vessel and engine type specific engine useful life.

Conversions

g to lb	0.002204634	
PM2.5/PM10	0.956	CARB CHC
HC to ROG	1.053	EPA 2005

	ef		ratio	Source	
CO2	10.21	kg/g		CARB CHC based on EPA 2018	10210
CH4	0.06	g/g	5.87659E-06	EPA 2018, Diesel Ships and Boats	
N2O	0.45	g/g	4.40744E-05	EPA 2018, Diesel Ships and Boats	

CARB Data from CHC Model and Inventory

Table H-1. Summary of Engine Profile Data from CARB Reporting Data

Vessel Type	Vessel Count	Auxiliary Engine			Main Engine		
		Engine Count	Average HP	Average MY	Engine Count	Average HP	Average MY
Barge-ATB	13	81	381	2006	-	-	-
Barge-Bunker	12	33	170	2009	-	-	-
Barge-Other	46	102	224	2002	-	-	-
Barge-Towed Petrochemical	9	26	331	2005	-	-	-
Commerical Fishing	797	377	86	1999	888	305	1996
Commercial Passenger Fishing	274	196	67	2003	488	416	2005
Crew/Supply	71	77	107	2003	156	570	2006
Dredge	20	28	390	2009	16	441	2007
Excursion	177	170	109	2001	311	412	2000
Ferry-Catamaran	32	52	121	2010	78	1810	2010
Ferry-Monohull	19	26	80	2003	38	1194	2000
Ferry-Short Run	16	14	44	2002	26	400	2010
Pilot Vessel	9	9	74	2004	17	781	2007
Research Vessel	44	45	171	1998	86	635	1996
Tugboat-ATB	11	34	296	2005	22	4395	2006
Tugboat-Escort/Ship Assist	58	122	179	2009	117	2450	2008
Tugboat-Push/Tow	108	162	93	2003	211	731	2002
Workboat	204	149	247	1998	327	471	2000

# of engines per vessel	
Aux	Main
6.2	-
2.8	-
2.2	-
2.9	-
0.5	1.1
0.7	1.8
1.1	2.2
1.4	0.8
1.0	1.8
1.6	2.4
1.4	2.0
0.9	1.6
1.0	1.9
1.0	2.0
3.1	2.0
2.1	2.0
1.5	2.0
0.7	1.6

Table H-4. Average Total CHC Annual Hours and Activity Fraction Within 24nm by Vessel and Engine Type

Vessel Type	Regular Engines Auxiliary engine (hours)	Regular Engines Main Engine (hours)	Low-Use Engines (regulated vessels) Auxiliary engine (hours)	Low-Use Engines (regulated vessels) Main Engine (hours)	Activity Fraction within 24nm
Barge-ATB	856	-	138	-	100%
Barge-Bunker	1616	-	141	-	100%
Barge-Other	1031	-	80	-	100%
Barge-Towed Petrochemical	1930	-	117	-	100%
Crew/Supply	2104	1811	100	206	100%
Dredge	1969	1227	66	218	98%
Excursion	1040	1070	189	202	99%
Ferry-Catamaran	1774	2372	231	289	100%
Ferry-Monohull	1654	2327	94	128	100%
Ferry-Short Run	2605	2674	213	131	100%
Tugboat-ATB	4504	2466	59	126	39%
Tugboat-Escort/ Ship Assist	2433	2676	186	157	100%
Tugboat-Push/Tow	1822	1550	153	153	86%
Commercial Fishing	1190	997	-	-	92%
Commercial Passenger Fishing	1650	1193	-	-	83%
Pilot Vessel	1887	2269	-	-	100%
Research Vessel	1037	957	-	-	82%
Workboat	717	639	-	-	97%

Table H-7. CHC Deterioration Rates by Horsepower Bin (percentage increase by end of useful life)

copied from MCAS; same DRs as previous rules

Horsepower Range	Engine Deterioration Factors PM	NOx	CO	HC
25-50	0.31	0.06	0.41	0.51
51-250	0.44	0.14	0.16	0.28
> 250	0.67	0.21	0.25	0.44

Model Year Range	ULSD Fuel Correction Factors PM	NOx	SO2	CO	HC	CO2	N2O	CH4
≥ 1995	0.720	0.930	0.043	1.000	0.720	1.000	0.930	0.720
1996-2010	0.800	0.948	0.043	1.000	0.720	1.000	0.948	0.720
2011+	0.852	0.948	0.043	1.000	0.720	1.000	0.948	0.720

Table H-8. CHC Engine Useful Life (Years) by Vessel Type and Engine Type

Vessel Type	Main Engine	Auxiliary Engine
Barges – All	25	14
Commercial Fishing	31	28
Commercial Passenger Fishing	16	19
Crew Supply	13	17
Dredge	15	13
Excursion	15	14
Ferries - All	15	13
Pilot Vessel	15	13
Research Vessel	22	28
Tugboats - All	14	16
Workboat	22	28

Table H-9. CHC Load Factor by Vessel and Engine Type

Vessel Type	Main Engine	Auxiliary Engine
Barge – All	-	0.31
Commercial Fishing	0.27	0.44
Commercial Passenger Fishing	0.29	0.45
Crew/Supply	0.26	0.40
Dredge	0.44	0.57
Excursion	0.27	0.40
Ferries - All	0.31	0.39
Pilot Vessels	0.33	0.32
Research Vessels	0.32	0.44
Tugboat-ATB	0.50	0.50
Tugboat-Escort/Ship Assist	0.16	0.34
Tugboat-Push/Tow	0.33	0.37
Workboat	0.33	0.32

Table H-6. CO2 Emission Factors and BSFC Rates of CHC Engines by Tier Standard and Horsepower Bin

Tier Standard	Horsepower Bin	CO2 EF (g/bhp-hr)	BSFC (lbs/bhp-hr)
0/1/2	0–99	592	0.408
0/1/2	>= 100	533	0.367
3	0–24	675	0.465
3	25–49	628	0.433
3	50–174	554	0.382
3	175–799	531	0.366
3	>= 800	515	0.355
4	>= 800	498	0.343

ZH EF - Tier 3 only

model_year	horsepower_bin	CO	HC	NOx	PM	bsfc_lbsperhphr	engine_type	tier	engine_type_id
2009	75	0.820207105	0.148588792	3.747924689	0.115702444	0.382	main	3	1
2009	25	0.949995857	0.167909683	4.285328005	0.166839966	0.465	main	3	1
2009	50	0.949995857	0.167909683	4.285328005	0.166839966	0.433	main	3	1
2009	100	0.820207105	0.148588792	3.747924689	0.115702444	0.382	main	3	1
2013	175	0.563421287	0.132067668	3.727711104	0.051280139	0.382	main	3	1
2013	300	0.563421287	0.132067668	3.727711104	0.051280139	0.366	main	3	1
2013	600	0.563421287	0.132067668	3.727711104	0.051280139	0.366	main	3	1
2013	800	0.563421287	0.132067668	3.727711104	0.051280139	0.366	main	3	1
2013	9999	0.736017897	0.168359871	3.692140436	0.05232318	0.355	main	3	1
2019	175	0.563421287	0.132067668	3.727711104	0.051280139	0.382	main	3	1
2013	300	0.563421287	0.132067668	3.727711104	0.051280139	0.366	main	3	1
2013	600	0.563421287	0.132067668	3.727711104	0.051280139	0.366	main	3	1
2013	800	0.563421287	0.132067668	3.727711104	0.051280139	0.366	main	3	1
2013	9999	0.736017897	0.168359871	3.692140436	0.05232318	0.355	main	3	1

Architectural Coatings Calculations

Building Coatings 1

Emissions based on Calculation Details in CalEEMod Users Guide

	SF	
Apaint = Apl x P%	20,300	Marine Program MU Building + Row House
Eap = EFap x Aparking	10,750	

w House

Unmitigated	Marine Program MU Building + Row House		*description*
VOC Emissions (lbs/day)	2.7		pounds of VOC per day; unmitigated
VOC Emissions (ton/year)	-		
E (day)	2.7		
E (annual)	-		
EF -exterior	0.00464		emission factor (lbs per sq. ft.)
New construction (sf)	31,050	Marine Program MU Building + Row House	
Days of coatings	108		
Construction SF per day	288		ft2
			exterior fraction of surface area. Default is 6%
C	**100**		**VOC content (g/L)**

Building Coatings 2

Calc Sumamry

Phase	Pounds per day	Tons per year
	ROG	ROG
Phase 1		
Phase 2		
Phase 3	2.7	0.14

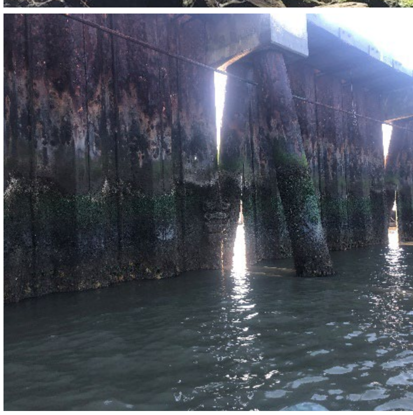
Appendix E

Aquatic Resources Technical Report

California State University Maritime Academy Waterfront Master Plan Project

Aquatic Resources Technical Report

Vallejo, Solano County, California



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List of Acronyms

ARTR	Aquatic Resources Technical Report
BCDC	San Francisco Bay Conservation and Development Commission
BIPV	Building-integrated photovoltaic technology
Cal Maritime	California State University Maritime Academy
CCR	California Code of Regulations
CDFW	California Department of Fish and Wildlife
CEMP	California Eelgrass Mitigation Policy and Implementing Guidelines
CESA	California Endangered Species Act
CEQA	California Environmental Quality Act
CFGC	California Fish and Game Code
CFR	Code of Federal Regulations
CMP	Comprehensive Management Plan
CNDDB	California Natural Diversity Database
CNPS	California Native Plant Society
Corps	U.S. Army Corps of Engineers
CPRC	California Public Resources Code
CSU	California State University
CWA	Clean Water Act
DMMO	Dredge Material Management Office
EFH	Essential Fish Habitat
EIR	Environmental Impact Report
EPA	U.S. Environmental Protection Agency
ESA	Federal Endangered Species Act
FE	Federal Endangered
FT	Federal Threatened
FTE	Full time equivalent
HCP	Habitat Conservation Plan
HTL	High tide line
Magnuson-Stevens Act	Magnuson-Stevens Fishery Conservation & Management Act
MHK	Marine Hydrokinetic Barge
MHW	Mean High Water
MLLW	Mean Low Low Water
MMPA	Marine Mammal Protection Act
NAVD88	North American Vertical Datum
NCCP	Natural Community Conservation Plan
NOAA	National Oceanic and Atmospheric Administration
NMFS	National Marine Fisheries Service
NSMV	National Security Multi-Mission Vessel
NTUs	Nephelometric Turbidity Units
OHWM	Ordinary High Water Mark
PTS	Post-Traumatic Stress
Proposed Project	Cal Maritime Waterfront Master Plan Project
PSU	Practical Salinity Units
Rank	California Rare Plant Ranks
RHA	Rivers and Harbors Act
RMS	Root Mean Square
RWQCB	Regional Water Quality Control Board

SAV	Submerged Aquatic Vegetation
SC	State Candidate
SEL	Accumulated Sound Exposure Level
SSC	Species of Special Concern
Sq ft	Square foot
ST	State Threatened
SWRCB	State Water Resource Control Board
TSGB	Training Ship Golden Bear
USC	U.S. Code
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VFWD	Vallejo Flood and Wastewater District
WRA	WRA, Inc.

1.0 INTRODUCTION

This Aquatic Resources Technical Report (ARTR) evaluates existing biological resources, potential impacts, and mitigation measures (if required) for the California State University Maritime Academy (Cal Maritime) Waterfront Master Plan Project (proposed Project) located along the shores of San Pablo Bay in the City of Vallejo, Solano County, California (Appendix A – Figure 1). Cal Maritime proposes the preparation of a Waterfront Master Plan to implement improvements along Cal Maritime's waterfront (Study Area, Figure 2, Appendix A). These improvements and upgrades will be constructed in three phases over the next 10+ years. Phase 1 will prepare the campus for the arrival of a new training ship, the National Security Multi-Mission Vessel (NSMV), to replace the existing Training Ship Golden Bear (TSGB). Phases 2 and 3 include other improvements to the waterfront such as an expanded boat basin, waterfront classrooms, and shoreline public access improvements. A higher level of detail is available for Phase 1 project components at the time of this report than is available for Phases 2 and 3. Each project phase is evaluated commensurate with the level of detail available.

1.1 Overview and Purpose

This report provides an assessment of biological resources within aquatic areas that may be affected by project activities to support completion of an Environmental Impact Report (EIR) prepared to comply with the California Environmental Quality Act (CEQA). This report describes the results of the site visits which assessed the Study Area for aquatic resources, including special-status species. Based on the results of the site assessment, potential impacts to sensitive aquatic resources were evaluated and measures to avoid, minimize, or mitigate potentially significant impacts are described.

An ARTR provides general information on the presence, or potential presence, of sensitive species and habitats. Additional focused studies including follow up surveys may be required to support regulatory permit applications or to implement mitigation measures included in this report. This assessment is based on information available at the time of the study and on-site conditions that were observed on the dates the site was visited. Conclusions are based on currently available information used in combination with the professional judgement of the biologists completing this study.

1.2 Location and Setting

The approximately 0.4-mile waterfront within the Study Area, known as Morro Cove, is located on the north shore of San Pablo Bay at the terminus of the Carquinez Strait and the Napa River, just west of the Carquinez Bridge, at the edge of the City of Vallejo. The waterfront is an active maritime facility which is a vital part of Cal Maritime's educational programming. The main pier and berth for the current TSGB and adjacent boat basin are the major features of the current waterfront. The concept for the full future buildout of the waterfront as described in the Waterfront Master Plan with Phase 1, 2 and 3 is shown in Figure 3 (Appendix A).

Access to the Study Area is provided by Maritime Academy Drive which intersects State Route 29/Sonoma Boulevard just north of Interstate 80 entry/exit ramps and provides primary vehicular access to the campus. Maritime Academy Drive descends from the northern and western portions of the campus, directing traffic along the eastern edge of the lower portion of the campus before terminating at the campus pier. Maritime Academy Drive and Morrow Cove Drive form a loop around the lower campus and provide access to the Study Area. The upland campus is immediately outside of the Study Area to the east and north and provides a network of walkways connecting buildings and open spaces, including the quad and shoreline. Pedestrian access between the lower and upper campus is provided via a sidewalk and a raised boardwalk along Maritime Academy Drive and through staircases where hillside topography necessitates. Beyond the campus, surrounding uses and points of interest include residential uses (the Crystal Pointe neighborhood) northwest of the campus, Carquinez Bridge Vista Point just east of the campus, and Livingstone's Inspiration Park and Bay Area Ridge Trail to the east on the far side of Interstate 80.

1.3 Background and Project Overview

Cal Maritime is one of 23 campuses in the California State University system. Established in 1929 as the California Nautical School, Cal Maritime is one of seven degree-granting maritime academies in the United States, and the only one on the west coast. It joined the CSU system in 1995 and provides an academic experience combining classroom learning with applied technology, leadership development and global awareness. The academy's approximately 0.4 -mile of waterfront along San Pablo Bay is the campus's dominant natural feature and the main focal point of Cal Maritime instruction and activities. A key part of the cadets' training is navigating and piloting a vessel at sea, which are key components in Cal Maritime's educational program that currently take place aboard the 500-foot TSGB. The TSGB serves as a floating classroom/laboratory where classroom concepts in marine transportation, engineering, and technology are practiced and applied.

Cal Maritime proposes the preparation of a Waterfront Master Plan to implement improvements along Cal Maritime's waterfront and in-water infrastructure to prepare for arrival of one of the next generation of state-of-the-art training ships—the NSMV—as well as other upgrades to be constructed in three phases over the next 10+ years. The project is described in detail in this chapter, including the project location, setting, goals and objectives, and components, as well as the permits and approvals that may be necessary during project implementation.

1.3.1 Project Objectives

The two-fold underlying purpose of the Waterfront Master Plan Project is to prepare the Cal Maritime campus waterfront for the 2026 arrival and subsequent operation of the NSMV, and to upgrade infrastructure and facilities that support other campus and public waterfront-dependent program needs. These other program needs include hands-on campus instruction related to small and large craft navigation, maintenance, and cargo and other ship provisioning operations; small craft mooring and storage; and public recreational use.

Consistent with, and in furtherance of these project purposes, the objectives of the proposed project are to:

- Upgrade Cal Maritime's in-water and landside facilities and infrastructure to accommodate berthing and operation of the NSMV, as follows:
    - Upgrade and enlarge the main pier to accommodate the larger NSMV, meet heavy weather mooring requirements, and allow access to the NSMV by trucks and equipment needed for operation and maintenance of the vessel
    - Dredge the existing and expanded boat basin approach to modify bathymetry and ensure sufficient depth to accommodate the increased draft of the NSMV

    - Provide necessary new and upgraded infrastructure and utilities sized to support the NSMV
- Redevelop the existing Marine Yard to accommodate improved access, outdoor shop functions, staging for the training of cadets to load/unload cargo, normal and emergency deployment operations, and Cal Maritime and US Coast Guard-required port security requirements
- Upgrade and replace infrastructure to facilitate efficient waterfront operations important for Cal Maritime's educational mission and expansion of cadet instruction
- Increase hands-on maritime instructional opportunities for cadets to move beyond traditional classroom experience and gain in-water experience
- Rehabilitate the boathouse in a manner that retains its historic integrity
- Expand and optimize the boat basin to allow simultaneous movement of more than two vessels for academic on-water instruction and recreational activities, accommodate Cal Maritime training and small recreational craft currently moored off-site due to lack of space, and accommodate an expanded Cal Maritime fleet of vessels including a new replacement tug, oceanographic or similar research vessel
- Ensure the TSGB remains accessible for instructional use during Phase One implementation of the Waterfront Master Plan
- Link campus buildings with waterfront open space and enhance public pedestrian and bicycle access to and along an activated waterfront
- Ensure waterfront resilience, including the shoreline upland and transition zones that support public open space and recreational use, to climate and storm-related stresses.

1.4 Project Description

Cal Maritime is proposing the preparation of a Waterfront Master Plan (Project) to implement improvements along Cal Maritime's waterfront and in-water infrastructure to prepare for arrival of the next generation of state-of-the-art training ships—the National Security Multi-Mission Vessel (NSMV)—as well as other upgrades to be constructed in three phases over the next 10+ years. NSMV delivery to Cal Maritime is scheduled for April 2026. The Waterfront Master Plan is intended to identify and integrate key projects into a comprehensive plan to guide redevelopment of Cal Maritime's in-water and landside facilities and infrastructure to support academic and port operations, public access, environmental factors, and long-term resiliency. The project would not change enrollment or student capacity on campus or alter projected growth of the university.

The approximately 31.28-acre project site (Assessor's Parcel Number 006-209-0030) is located within the Cal Maritime campus boundaries in the City of Vallejo, at the foot of the Carquinez Bridge in southwest Solano County. The approximately half-mile of waterfront, which is bordered by Morrow Cove Drive to the north, is the campus' dominant natural feature and the main focal point of Cal Maritime instruction and activities. The main pier and berth for the existing training ship, Training Ship Golden Bear (TSGB), and adjacent boat basin are major features of the southeastern edge of the waterfront. The entirety of the waterfront and in-water marine structures make up the entire project site covered by of the Waterfront Master Plan.

The Waterfront Master Plan establishes a vision for achieving a campus waterfront aligned with the unique academic and maritime operations, environmental factors, and resiliency needs of Cal Maritime. The plan identifies three phases of development over the next 10 years focusing on upgrades to in-water infrastructure, renovation and development of waterfront buildings, enhancement of waterfront open space and connectivity, and expansion of site-serving utilities (Figure 3).

Phase One of the proposed project focuses on upgrades to in-water infrastructure and the Marine Yard, as well as expansion of site-serving utilities (Figure 4). Phase One components would include:

- NSMV arrival and operation;
- main pier demolition and replacement;
- existing trestle structural upgrades and extension (or possible replacement);
- temporary relocation and operation of the TSGB and small vessel programs;
- upgrades of all pier utilities connections and delivery lines for power, sewer, stormwater, gas, fire suppression, and potable water;
- clamshell or mechanical only maintenance dredging of the existing boat basin and new clamshell or mechanical only dredging in the expanded boat basin;
- installation of navigation aids;
- replacement of floating docks at the boat basin;
- upgrades to the Marine Yard, which would be limited to those needed to support the new pier and extended trestle (or possibly trestle replacement);
- utilities relocation and/or upgrades, including upgraded electrical equipment and gas supply and metering; potable water line expansion; sanitary sewer expansion; shore power, fire suppression, and lighting upgrades and possible removal of the steam plant; and
- temporary TSGB berth accommodations at Suisun Bay Reserve Fleet through fall 2026. After the arrival of the NSMV the TSGB will be transferred permanently to MARAD.

Phase Two of the proposed project would focus on project objectives to rehabilitate the boathouse, expand and optimize the boat basin, redevelop the existing Marine Yard, increase hands-on instructional opportunities, link campus buildings to waterfront open space, enhance public access, and safeguard waterfront resilience and ecological functioning. Phase Two of the proposed project involves activities that are not critical to support the arrival of the NSMV but that are important for Cal Maritime's educational mission and expansion of cadet instruction. Phase Two components would include:

- seismic retrofit and renovation of the boathouse,
- upland improvement for new pier and creation of Boat Basin 2,
- new floating and training docks at Boat Basin 2, and
- shoreline enhancements between the boathouse and new pier.

Phase Three of the proposed project would focus on objectives to redevelop the existing Marine Yard, increase hands-on instructional opportunities, link campus buildings to waterfront open space, enhance public access, and safeguard waterfront resilience and ecological functioning.

Phase Three of the project would add classrooms and outdoor learning spaces associated with the Marine Programs Multi-Use Building. A marine hydrokinetic (MHK) barge and linking trestle would also be constructed during this phase. This phase would also focus on improvement of the campus-coastline linkage and open spaces and a heightened level of resilience to climate- and storm-related stresses. Phase Three components would include:

- Marine Programs Multi-Use Building,
- harbor control tower,
- MHK barge and linking trestle,
- central waterfront esplanade canopy,
- row house and floating landing,
- shoreline enhancements between the row house and dining center,
- waterfront overlook/outdoor room one, and
- waterfront overlook/outdoor room two.

Construction of Phase One is anticipated to occur between summer 2025 with completion expected in fall 2026. The TSGB and small vessels programs would be relocated during reconstruction of and expansion of the main pier. The TSGB and two small vessels would be berthed for the duration of construction, potentially starting in 2025 and concluding in 2026 with the arrival of the NSMV, at Suisun Bay Reserve Fleet, a MARAD facility. Phases Two and Three are conceptual at this time because detailed information related to construction activities is currently unknown. However, Phase Two is anticipated to be implemented over approximately 6 years commencing in 2027, after the arrival of the NSMV. Phase Three would take place thereafter as funding is available.

2.0 REGULATORY BACKGROUND

The following sections explain the regulatory context of the biological assessment, including applicable laws and regulations that were applied to the field investigations and analysis of potential project impacts.

2.1 Federal and State Regulatory Setting

2.1.1 Vegetation and Aquatic Communities

CEQA provides protections for particular vegetation types defined as sensitive by the California Department of Fish and Wildlife (CDFW) and aquatic features protected by laws and regulations administered by the U.S Army Corps of Engineers (Corps), State Water Resources Control Board (SWRCB), and Regional Water Quality Control Boards (RWQCB). The laws and regulations that provide protection for these resources are summarized below.

SENSITIVE NATURAL COMMUNITIES

Sensitive natural communities include habitats that fulfill special functions or have special values. Natural communities considered sensitive are those identified in local or regional plans, policies, regulations, or by the CDFW. CDFW ranks sensitive communities as "threatened" or "very threatened" (CDFW 2023a) and keeps records of their occurrences in its California Natural Diversity Database (CNDDB; CDFW 2023b). Natural communities are ranked 1 through 5 in the CNDDB based on NatureServe's (2020) methodology, with those communities ranked globally (G) or statewide (S) as 1 through 3 considered sensitive. Impacts to sensitive natural communities identified in local or regional plans, policies, or regulations or those identified by the CDFW or U.S. Fish and Wildlife Service (USFWS) must be considered and evaluated under CEQA (California Code of Regulations [CCR] Title 14, Div. 6, Chap. 3, Appendix G). In addition, this general class includes oak woodlands that are protected by local ordinances under the Oak Woodlands Protection Act and Section 21083.4 of California Public Resources Code (CPRC).

WATERS OF THE UNITED STATES, INCLUDING WETLANDS

The Corps regulates "Waters of the United States" under Section 404 of the Clean Water Act (CWA). Waters of the United States are defined in the Code of Federal Regulations (CFR) as including the territorial seas, and waters which are currently used, or were used in the past, or may be susceptible to use in interstate or foreign commerce, such as tributaries, lakes and ponds, impoundments of waters of the U.S., and wetlands that are hydrologically connected with these navigable features (33 CFR 328.3). Potential wetland areas, according to the three criteria used to delineate wetlands as defined in the *U.S. Army Corps of Engineers Wetlands Delineation Manual* (Corps Manual; Environmental Laboratory 1987), are identified by the presence of (1) hydrophytic vegetation, (2) hydric soils, and (3) wetland hydrology. Unvegetated waters including lakes, rivers, and streams may also be subject to Section 404 jurisdiction and are characterized by an ordinary high water mark (OHWM) identified based on field indicators such as the lack of vegetation, sorting of sediments, and other indicators of flowing or standing water. The placement of fill material into Waters of the United States generally requires a permit from the Corps under Section 404 of the CWA.

The Corps also regulates construction in navigable waterways of the U.S. through Section 10 of the Rivers and Harbors Act (RHA) of 1899 (33 U.S. Code [USC] 403). Section 10 of the RHA requires Corps approval and a permit for excavation or fill, or alteration or modification of the course, location, condition, or capacity of, any port, roadstead, haven, harbor, canal, lake, harbor or refuge, or enclosure within the limits of any breakwater, or of the channel of any navigable water of the United States. Section 10 requirements apply only to navigable waters themselves, and are not applicable to tributaries, adjacent wetlands, and similar aquatic features not capable of supporting interstate commerce.

WATERS OF THE STATE, INCLUDING WETLANDS

The term "Waters of the State" is defined by the Porter-Cologne Act as "any surface water or groundwater, including saline waters, within the boundaries of the state." The SWRCB and nine RWQCB protect waters within this broad regulatory scope through many different regulatory programs. Waters of the State in the context of a CEQA Biological Resources evaluation include wetlands and other surface waters protected by the *State Wetland Definition and Procedures for Discharges of Dredged or Fill Material to Waters of the State* (SWRCB 2019). The SWRCB and RWQCB issue permits for the discharge of fill material into surface waters through the State Water Quality Certification Program, which fulfills requirements of Section 401 of the CWA and the Porter-Cologne Water Quality Control Act. Projects that require a Clean Water Act permit are also required to obtain a Water Quality Certification. If a project does not require a federal permit but does involve discharge of dredge or fill material into surface waters of the State, the SWRCB and RWQCB may issue a permit in the form of Waste Discharge Requirements.

SAN FRANCISCO BAY AND SHORELINE

Enacted in 1965, the McAteer-Petris Act (California Government Code Section 66600 *et seq.*) established the San Francisco Bay Conservation and Development Commission (BCDC) as a state agency charged with preparing a plan for the long-term use of the Bay. BCDC has several areas of jurisdiction, including San Francisco Bay (including sloughs and marshlands lying between mean high tide and five feet above mean sea level) and a shoreline band consisting of all territory located between the shoreline of the Bay and a line 100 feet landward of and parallel with the shoreline (California Government Code 66610). Any person or governmental agency wishing to place fill, to extract materials, or to make any substantial change in use of any water, land, or structure within BCDC jurisdiction must secure a permit from BCDC.

2.1.2 Special-status Species

ENDANGERED AND THREATENED FISH, AND WILDLIFE

Specific species of plants, fish, and wildlife species may be designated as threatened or endangered by the federal Endangered Species Act (ESA), or the California Endangered Species Act (CESA). Specific protections and permitting mechanisms for these species differ under each of these acts, and a species' designation under one law does not automatically provide protection under the other.

The ESA (16 USC 1531 et seq.) is implemented by the USFWS and the National Marine Fisheries Service (NMFS). The USFWS and NMFS maintain lists of endangered and threatened plant and animal species (referred to as "listed species"). "Proposed" or "candidate" species are those that are being considered for listing and are not protected until they are formally listed as threatened or endangered. Under the ESA, authorization must be obtained from the USFWS or NMFS prior to take of any listed species. "Take" under the ESA is defined as "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct." Take under the ESA includes direct injury or mortality to individuals, disruptions in normal behavioral patterns resulting from factors such as noise and visual disturbance, and impacts to habitat for listed species. Actions that may result in take of an ESA-listed species may obtain a permit under ESA Section 10, or via the interagency consultation described in ESA Section 7. Federally listed plant species are only protected when take occurs on federal land.

The ESA also provides for designation of critical habitat, which are specific geographic areas containing physical or biological features "essential to the conservation of the species." Protections afforded to designated critical habitat apply only to actions that are funded, permitted, or carried out by federal agencies. Critical habitat designations do not affect activities by private landowners if there is no other federal agency involvement.

The CESA (CFGC 2050 et seq.) prohibits the take of any plant and animal species that the CFGC determines to be an endangered or threatened species in California. CESA regulations include take protection for threatened and endangered plants on private lands, as well as extending this protection to candidate species that are proposed for listing as threatened or endangered under CESA. The definition of a "take" under CESA ("hunt, pursue, catch, capture, or kill, or attempt to hunt, pursue, catch, capture, or kill") only applies to direct impact to individuals, and does not extend to habitat impacts or harassment. CDFW may issue an Incidental Take Permit under CESA to authorize take if it is incidental to otherwise lawful activity and if specific criteria are met. Take of these species is also authorized if the geographic area is covered by a Natural Community Conservation Plan (NCCP), as long as the NCCP covers that activity.

FULLY PROTECTED SPECIES

This category includes specific species that are designated in the CFGC as protected even if not listed under CESA or ESA. Fully Protected Species includes specific lists of birds, mammals, reptiles, amphibians, and fish designated in CFGC. Fully protected species may not be taken or possessed at any time. No licenses or permits may be issued for take of fully protected species, except for necessary scientific research and conservation purposes. The definition of "take" is the same under the California Fish and Game Code and the CESA. By law, CDFW may not issue an Incidental Take Permit for Fully Protected Species.

SPECIAL PROTECTIONS FOR NESTING BIRDS

The federal Bald and Golden Eagle Protection Act provides relatively broad protections to both of North America's eagle species (bald eagle [*Haliaeetus leucocephalus*] and golden eagle [*Aquila chrysaetos*]) that in some regards are similar to those provided by the ESA. In addition to regulations for special-status species, most native birds in the United States, including non-status species, have baseline legal protections under the Migratory Bird Treaty Act of 1918 and CFGC, i.e., sections 3503, 3503.5 and 3513. Under these laws/codes, the intentional harm or collection of adult birds as well as the intentional collection or destruction of active nests, eggs, and young is illegal.

ESSENTIAL FISH HABITAT

The Magnuson-Stevens Fishery Conservation and Management Act provides for conservation and management of fishery resources in the U.S., administered by NMFS. This Act establishes a national program intended to prevent overfishing, rebuild overfished stocks, ensure conservation, and facilitate long-term protection through the establishment of Essential Fish Habitat (EFH).

EFH consists of aquatic areas that contain habitat essential to the long-term survival and health of fisheries, which may include the water column, certain bottom types, vegetation (e.g., eelgrass (*Zostera* spp.)), or complex structures such as oyster beds. Any federal agency that authorizes, funds, or undertakes action that may adversely affect EFH is required to consult with NMFS.

MARINE MAMMALS

The Marine Mammal Protection Act (MMPA) was enacted in 1972 and protects all marine mammals within the territorial boundaries of the United States from take. The definition of "take" in the MMPA is the same as that under the FESA. The law is administered by the NMFS, who may issue permits for incidental take and importation of marine mammals in certain circumstances.

SPECIES OF SPECIAL CONCERN, MOVEMENT CORRIDORS, AND OTHER SPECIAL-STATUS SPECIES UNDER CEQA

To address additional species protections afforded under CEQA, CDFW has developed a list of special species as “a general term that refers to all of the taxa the CNDDB is interested in tracking, regardless of their legal or protection status.” This list includes lists developed by other organizations, including for example, the Audubon Watch List Species, the Bureau of Land Management Sensitive Species, and USFWS Birds of Special Concern. Additionally, any species listed as sensitive within local plans, policies and ordinances are likewise considered sensitive. Movement and migratory corridors for native wildlife (including aquatic corridors) as well as wildlife nursery sites are given special consideration under CEQA.

2.2 Local Plans and Policies

<u>City of Vallejo General Plan 2040</u>. The General Plan contains policies/actions pertaining to the following biological resources categories that are relevant to the Study Area:

- **Wetlands, streams, riparian, and aquatic areas**
    - Action NBE-1.1F: Conduct surveys, assess project impacts, determine protective measures for sensitive resources.
    - Action NBE-1.1G: No net loss in aquatic feature acreage or habitat value
    - Action NBE-1.2D: Continue requiring environmental review for development project to achieve no net loss of sensitive habitat acreage, value, and functions.
- **Wildlife Species**
    - Action NBE-1.1F: Conduct surveys, assess project impacts, determine protective measures for sensitive resources
    - Action NBE-1.2C: Nesting bird protection
    - Action NBE-1.2D: Continue requiring environmental review for development project to achieve no net loss of sensitive habitat acreage, value, and functions
- **Wildlife Corridors**
    - Action NBE-1.1B: Continue participation in regional programs, including the Solano Multispecies HCP/NCCP

3.0 ASSESSMENT METHODOLOGY

On July 11 and August 12, 2022, as well as August 1, 2023, WRA, Inc. (WRA) biologists visited the Study Area to map aquatic vegetation, aquatic features, and other land cover types; document plant and wildlife species present; and evaluate on-site habitat for the potential to support special-status species as defined by CEQA. Prior to the site visit, WRA biologists reviewed literature resources and performed database searches to assess the potential for sensitive land cover types and special-status species, including:

- Soil Survey of Solano County, California (USDA 2023)
- Benecia 7.5-minute U.S. Geological Survey (USGS) quadrangle (USGS 2023)
- Contemporary aerial photographs (Google Earth 2023)
- Historical aerial photographs (NETR 2023)
- National Wetlands Inventory (USFWS 2023a)
- California Aquatic Resources Inventory (SFEI 2023)
- CNDDB (CDFW 2023b)
- California Native Plant Society (CNPS) Inventory (CNPS 2023a)
- Consortium of California Herbaria (CCH1 2023, CCH2 2023)
- USFWS Information for Planning and Consultation (USFWS 2023b)
- eBird Online Database (eBird 2023)
- California Bird Species of Special Concern in California (Shuford and Gardali 2008)
- California Amphibian and Reptile Species of Special Concern (Thomson et al. 2016)
- A Field Guide to Western Reptiles and Amphibians (Stebbins 2003)
- A Manual of California Vegetation, Online Edition (CNPS 2023b)
- California Natural Community List (CDFW 2023a)
- Database searches (i.e., CNDDB, CNPS) for special-status species focused on the Benecia, Mare Island, Cuttings Wharf, Cordelia, Fairfield South, Vine Hill, Walnut Creek, Briones Valley, and Richmond USGS 7.5-minute quadrangles.
- Bay wide eelgrass survey and assessment (BCDC 2020).

Following the remote assessment, WRA biologists completed a field review over the course of three days to document existing conditions and to determine if such provide suitable habitat for any special-status plant or wildlife species.

Though terrestrial land covers comprise a portion of the Study Area, the intent of this report is solely to assess the potential for special-status species within aquatic communities. As such, only those species that have potential to occur within the aquatic communities described below are discussed and analyzed.

3.1 Aquatic Communities and Other Land Cover Types

During the site visit, WRA evaluated the species composition and area occupied by distinct vegetation communities, aquatic features, and other land cover types. Mapping of these classifications utilized a combination of aerial imagery and ground surveys.

3.1.1 Vegetation Communities

In most instances, communities are characterized and mapped based on distinct shifts in plant assemblage (vegetation) and follow the California Natural Community List (CDFW 2023a) and A Manual of California Vegetation, Online Edition (CNPS 2023b). These resources cannot anticipate every component of every potential vegetation assemblage in California, and so in some cases, it is necessary to identify other appropriate vegetative classifications based on best professional judgment of WRA biologists. When undescribed variants are used, it is noted in the description. Vegetation alliances (natural communities) with a CDFW Rank of 1 through 3 (globally critically imperiled [S1/G1], imperiled [S2/G2], or vulnerable [S3/G3]) (CDFW 2023a), were evaluated as sensitive as part of this evaluation.

3.1.2 Aquatic Features and Jurisdictional Boundaries

The site was reviewed for the presence of wetlands and other aquatic resources according to the methods described in the *Corps Manual* (Environmental Laboratory 1987), the *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Arid West* (Corps 2008), and *A Field Guide to the Identification of the Ordinary High Water Mark in the Arid West Region of the Western United States* (Lichvar and McColley 2008). Areas meeting these indicators were mapped as aquatic resources and categorized using the vegetation community classification methods described above. Aquatic communities which are mapped in the NMFS EFH Mapper (NMFS 2023) or otherwise meet criteria for designation as EFH are indicated as such in the community description below in Section 5.3. The presence of riparian habitat was evaluated based on woody plant species meeting the definition of riparian provided in *A Field Guide to Lake and Streambed Alteration Agreements, Section 1600-1607, California Fish and Game Code* (CDFG 1994) and based on best professional judgement of biologists completing the field surveys.

EELGRASS BEDS

Multiple eelgrass surveys were conducted by WRA biologists on July 11 and August 12, 2022, as well as on August 1, 2023. The methods for the survey were based on the California Eelgrass Mitigation Policy and Implementing Guidelines (CEMP) prepared by National Marine Fisheries Service (NMFS; NMFS 2014). All surveys were conducted within the growing season for Northern California eelgrass as identified in the CEMP (NMFS 2014).

Eelgrass surveys were planned and conducted during low tides via kayaks for maximum visibility and identification of even small patches of eelgrass. Visual surveys of all existing habitats, structures, and future work areas (including under the boat house, pier, and break water) were conducted using line transects. Kayaks/surveyors were positioned 10-20 meters apart depending on depth, location, and environmental conditions. If observed, eelgrass beds were mapped using a GPS capable of sub-meter accuracy, per spatial distribution guidance in the CEMP.

ARMY CORPS AND REGIONAL WATER QUALITY CONTROL BOARD JURISDICTIONAL BOUNDARY

In tidal areas, the upper extent of the Corps/RWQCB jurisdiction is mapped up to the high tide line (HTL). The high tide line in the Study Area was determined based on the elevation of the highest predicted tides at the closest National Oceanic and Atmospheric Administration (NOAA) tide station (Davis Point, 9415141). The HTL is shown on Figure 5 (Appendix A) and also represents the limit to areas evaluated for this ARTR as aquatic habitats.

BCDC JURISDICTIONAL BOUNDARY

BCDC's jurisdictional boundaries include (a) BCDC's "Bay Jurisdiction", which in this location includes all tidally influenced areas below the elevation of mean high water (MHW), and (b) BCDC's "Shoreline Band" jurisdiction, which includes areas of the shoreline within 100 feet of MHW. The Davis Point NOAA tide station is used to determine the locations of these limits.

3.2 Special-status Species

3.2.1 General Assessment

Potential occurrence of special-status species in the Study Area was evaluated by first determining which special-status species occur in the vicinity of the Study Area through a literature and database review as described above. Presence of suitable habitat for special-status species was evaluated during the site visits based on physical and biological conditions of the site as well as the professional expertise of the investigating biologists. The potential for each special-status species to occur in the Study Area was then determined according to the following criteria:

- **No Potential.** Habitat on and adjacent to the site is clearly unsuitable for the species requirements (foraging, breeding, cover, substrate, elevation, hydrology, plant community, site history, disturbance regime).
- **Moderate Potential.** Some of the habitat components meeting the species requirements are present, and/or only some of the habitat on or adjacent to the site is unsuitable. The species has a moderate probability of being found on the site only during certain rare conditions (e.g. high outflows associated with large storms in winter).
- **High Potential.** All of the habitat components meeting the species requirements are present and/or most of the habitat on or adjacent to the site is highly suitable. The species has a high probability of being found on the site. This category is also used for species which are known to seasonally migrate through waters of the Study Area. Because the species is only present for limited portions of the year, the species is given a high potential as it only occurs seasonally.
- **Present.** This species has been observed on the site or has been recorded (i.e., CNDDB, other reports) on the site in the recent past. This category is also used for species which are known to occur year-round within waters of the Study Area. Other species which are known to occur seasonally during migrations also fall into this category. Those species are noted as "Seasonally Present."
- **Incidentally Present.** The species may be present from time to time, often related to seasonal changes in temperature and salinity, but is not dependent on the Study Area to complete key aspects of their life cycle such as breeding, feeding and foraging.

If a special-status species was observed during the site visit, its presence was recorded and discussed below in Section 5.2. If designated critical habitat is present for a species, the extent of critical habitat present and an evaluation of critical habitat elements is provided as part of the species discussions below.

3.3 Wildlife Corridors and Native Wildlife Nursery Sites

To account for potential impacts to wildlife movement/migratory corridors, biologists reviewed maps from the California Essential Connectivity Project (CDFW 2023), and habitat connectivity data available through the CDFW Biogeographic Information and Observation System (CDFW 2023c). Additionally, aerial imagery (Google Earth 2023) for the local area was referenced to assess if local core habitat areas were present within, or connected to the Study Area. This assessment was refined based on observations of on-site physical and/or biological conditions, including topographic and vegetative factors that can facilitate wildlife movement, as well as on-site and off-site barriers to connectivity.

The potential presence of native wildlife nursery sites is evaluated as part of the site visit and discussion of individual wildlife species below. Examples of native wildlife nursery sites include nesting sites for native bird species (particularly colonial nesting sites), marine mammal pupping sites, and colonial roosting sites for other species (such as for monarch butterfly [*Danaus plexippus*]).

4.0 ECOLOGICAL SETTING

The approximately 31.28-acre Study Area is in the waters of Morrow Cove and San Pablo Bay, within the City of Vallejo, Solano County. The Study Area is northwest of the Carquinez Strait and slightly south of the terminus of the Napa River which connects northward through the Mare Island Strait. The Study Area includes all areas affected by the Project. Additional details of the local setting are below.

4.1 Soils and Topography

The overall topography of the upland portions of the Study Area is flat, to sloped in the southern portion of the Study Area, with elevations ranging from approximately 0 to 45 feet above sea level. According to the *Soil Survey of Solano County* (USDA 2023), the Study Area is underlain by three soil mapping units: Dibble-Los Osos clay loams, 9 to 30 percent slopes, Dibble-Los Osos clay loams, 30 to 50 percent slopes, and made land. Water consists of the majority (75%) of the Study Area. Soils within the Study Area are shown in Figure 6 (Appendix A). The parent soil series of all the Study Area's mapping units are summarized below.

> **Dibble-Los Osos Series:** This series consists of shallow clay loam soils formed from residuum weathered from sandstone and sedimentary rock, and is situated on hill or mountain backslopes and summits at elevations ranging from 100 to 2,000 feet. This soil series is not considered hydric; these soils are well drained with very high runoff rates (USDA 2023). This soil series is slightly acidic (pH 6.1) and is not derived from ultramafic materials/not serpentine within the Study Area (USDA 2023). This soil series is in the southeastern portion of the Study Area, within the grasslands at the base of the hill, and in the northwestern corner of the Study Area, where it is developed.

Made Land: This series consists of mine spoil or earthy fill and is situated on toeslopes at elevations ranging from 0 to 2,500 feet (USDA 2023). These soils are not considered hydric. Made Land underlays most of the developed area within the Study Area.

4.2 Climate and Hydrology

The Study Area is in the coastal region of Vallejo in Solano County. The average monthly maximum temperature in the area is 70 degrees Fahrenheit, while the average monthly minimum temperature is 45 degrees Fahrenheit. Predominantly, precipitation falls as rainfall between November and March with an annual average precipitation of 22 inches.

The local watersheds include the San Pablo Bay Estuaries and American Canyon Creek-Frontal San Pablo Bay Estuaries (HUC 12: 180500020801 and 180500020401, respectively). The Study Area is in the lower portion of the San Pablo Bay regional watershed (HUC 8: 18050002). Morrow Cove is the primary aquatic feature of the Study Area; there are no blue-line streams within the Study Area that empty to Morrow Cove (USGS 2023). Detailed descriptions of aquatic resources are provided in Section 5.1 below.

4.3 Land Use

The majority of the Study Area is open waters with development present throughout much of the shoreline areas from historic maritime activities (e.g., former dock and wharf infrastructure) as well as current overwater infrastructure associated with the Cal Maritime facilities. Undeveloped areas consist solely of open bay waters, and a small patch of grassland within the adjacent uplands associated with Semple Point at the base of the Vallejo-Carquinez Bridge. Developed areas include the docks, and wharves which form the current overwater structures mentioned above, as well as shoreline hardening with riprap, lawns, buildings used for ship maintenance and roadways to access all such areas. Within the terrestrial portions of the Study Area, grassland habitat on sloped hills are located in the southeastern portion that is associated with Semple Point. Detailed land cover type descriptions are included in Section 5.1 below, and all observed plant species are included in Appendix B. Surrounding land uses include residential development (and patches of open space within the residential complexes) to the north and east, with open water to the south and west (Google Earth 2023). Historically, the Study Area was a ferryboat terminal surrounded by undeveloped open space, prior to Cal Maritime establishing its campus at that location in 1940s (Peterson 2004, NETR 2023).

5.0 ASSESSMENT RESULTS

5.1 Vegetation Communities and Other Land Cover

WRA observed six land cover types within the Study Area: developed, ruderal/disturbed, riprap shoreline, overwater structure, eelgrass beds, and water. Land cover types within the Study Area are illustrated in Figure 5 (Appendix A) and summarized below in Table 1. The non-sensitive land cover types in the Study Area include ruderal/disturbed and developed areas, while the sensitive communities include riprap shoreline and water (intertidal and subtidal). No other potentially jurisdictional aquatic features (e.g., streams, wetlands) are present.

Table 1. Vegetation Communities and Other Land Cover Types

COMMUNITY / LAND COVERS	SENSITIVE STATUS	RARITY RANKING	ACRES WITHIN STUDY AREA	% WITHIN STUDY AREA*
TERRESTRIAL				
Developed	No	None	3.55	11
Ruderal/Disturbed	No	None	0.50	2
AQUATIC				
Riprap shoreline (intertidal)	Yes	None	0.29	1
Overwater structure	No	None	0.51	2
Eelgrass beds	Yes	GNR/S3	0.15	0.05
Water (subtidal)	Yes	None	26.28	84

*Values do not total to 100 percent due to rounding

5.1.1 Terrestrial Land Cover

DEVELOPED AREA (NO VEGETATION ALLIANCE). CDFW RANK: NONE

Most of the terrestrial portion of the Study Area consist of developed area, where the Cal Maritime and its ancillary structures/infrastructure are located. The developed area total 3.55 acres within the Study Area. Vegetation within the developed areas consist of maintained lawns and ornamental plantings. Portions of the riprap shoreline are included in the developed area if it is above the HTL. This community is not considered sensitive by Solano County, CDFW, or any other regulatory entity.

RUDERAL/DISTURBED (NO VEGETATION ALLIANCE). CDFW RANK: NOT SENSITIVE

This is limited to the southeastern portion of the Study Area, associated with Semple Point at the base of the Vallejo-Carquinez Bridge. This consists of 0.50 acres, or 2 percent of the Study Area. This area has a history of disturbance from slope stabilization activities associated with Interstate 80 and Cal Maritime safety improvements. This portion of the Study Area is not included as part of the ornamental lawns within the developed area. This community is not considered sensitive by Solano County, CDFW, or any other regulatory entity.

5.1.2 Aquatic Resources

RIPRAP SHORELINE (NO VEGETATION ALLIANCE). CDFW RANK: NONE

The riprap shoreline is located to the west of the Study Area, and consists of abiotic substrate, with some algal growth. Sea lettuce and limpet barnacles were observed along the riprap shoreline. However, there was no significant sediment deposition observed within the riprap shoreline that would facilitate vegetative growth. No mussels or other shellfish beds were observed. The riprap shoreline is measured from the MHW to HTL and consists of 0.29 acres (1 percent of Study Area) and runs the entire length of the Study Area. This community is not considered sensitive by Solano County, CDFW, or any other regulatory entity, but is potentially under the jurisdiction of the Corps, RWQCB, and BCDC.

OVERWATER STRUCTURE (NO VEGETATION ALLIANCE). CDFW RANK: NONE

Overwater structures are present within the open waters of the Study Area and are comprised of the main pier that berths the TSGB, a mooring dolphin, floating docks, and a boat house structure that totals 0.51 acre. This land cover is not considered an aquatic community, nor is it considered sensitive by Solano County, CDFW, or any other regulatory entity, but is included under aquatic resources due to its location within open waters. Modification to these elements would be potentially under the jurisdiction of the Corps, RWQCB, and BCDC.

EELGRASS BEDS (*ZOSTERA MARINA/PACIFICA* PACIFIC AQUATIC HERBACEOUS ALLIANCE). CFDW RANK: SENSITIVE

Eelgrass (*Zostera* spp.) are submerged aquatic species adapted and highly specialized to life in the marine environment, growing along nearshore environments, favoring saline or brackish waters (i.e., minimum salinities of 10 PSU; NRCS 2012)[1]. Eelgrass forms a complex and highly productive underwater landscape, of which they are the dominant vegetation. Eelgrass reproduces by seed and rhizomatous growth, growing rapidly during the spring and summer months and beginning to decay during the fall and winter. Dead eelgrass blades wash up onto the shore frequently where their decay contributes essential nutrients to coastal environments. This unique habitat type is highly dynamic and supports a large diversity of fin and shellfish species, plankton, and invertebrates. Fish such as Pacific herring (*Clupea pallasii*), juvenile salmon (*Oncorhynchus spp.*), and ling cod (*Ophiodon elongatus*) use this habitat type as a fundamental food source and refuge. Eelgrass is also an important food source for waterbirds. Algae and invertebrate species such as amphipods, snails, crabs, and shrimp use eelgrass as substrate and food source. In addition, eelgrass beds can protect coastal areas from shoreline erosion and destruction. Eelgrass in the Bay serves as not only an important role in the food web, but additionally as a moderator of ocean pH and carbon sink.

Within the Study Area, eelgrass beds are located in restricted areas immediately adjacent to the shoreline, at approximately 1-3 feet in depth at low tide. The Study Area is located near the confluence of the Napa River and the Carquinez Strait, at the eastern edge of San Pablo Bay. This location provides significant sources of freshwater input and as such lies near the easternmost extent of the spatial distribution of eelgrass in the San Francisco Bay Estuary (SFEI 2023). Eelgrass in the Study Area is sparse and ephemeral due to the dramatic shifts in the seasonal salinity gradient ranging from fresh to near marine (0 - 20 PSU; EPA 2015) at this location. Long-term precipitation patterns and shifting salinity zones are a significant factor in determining eelgrass bed density and distribution at any given time. In years with higher precipitation levels, eelgrass beds are sparse or not present due to the higher input of freshwater. In dryer years or during periods of drought, eelgrass beds may be more widespread and denser due to the increased water salinity. The extent of eelgrass in the Study Area was originally based on the July/August 2022 survey and is a static snapshot of the system following a fairly prolonged drought period (see Figure 5, Appendix A). Mapping by the San Francisco Estuary Institute has shown similar patterns of distribution in previous years. The survey completed in August of 2023, after a year of higher-than-normal rainfall, did not find any eelgrass present within the Study Area. This shows the annual variation in eelgrass presence due to the Study

[1] Practical Salinity Units (PSU) is a dimensionless descriptor for the Practical Salinity Scale and is roughly equal to parts per thousand.

Area location at the eastern margins of eelgrass distribution in San Francisco Bay. Eelgrass is considered a sensitive community and is EFH as regulated by NMFS. However, the sparse, ephemeral nature of eelgrass within the Study Area is important to consider when evaluating the significance of potential impacts to eelgrass from the Project.

OPEN WATER (SUBTIDAL, NO VEGETATION ALLIANCE). CDFW RANK: NONE

All open waters within the Study Area are comprised of subtidal or intertidal waters and are part of Morrow Cove. Open water comprises the majority of the Study Area (26.28 acres/84 percent) and are mapped below the MHW. Open waters also contain several habitat for many special status species, discussed further below. Open waters are considered sensitive under CEQA.

5.2 Special-status Species

5.2.1 Special-status Plants

The analysis of this report is concentrated on only those plant species with potential to occur within aquatic habitats. Based upon a review of the resource databases listed in Section 3.0, 11 special-status aquatic dependent plant species have been documented in the vicinity of the Study Area. However, none of these species have the potential to occur within the aquatic land covers of the Study Area for one or more of the following reasons:

- Hydrologic conditions (e.g., riverine) necessary to support the special-status plant species are not present in the Study Area;
- Edaphic (soil) conditions (e.g., volcanic tuff, serpentine, clay soils) necessary to support the special-status plant species are not present in the Study Area;
- Topographic conditions (e.g., north-facing slope, montane) necessary to support the special-status plant species are not present in the Study Area;
- Unique pH conditions (e.g., alkali scalds, acidic bogs) necessary to support the special-status plant species are not present in the Study Area;
- Associated natural communities (e.g., interior chaparral, vernal pool complex) necessary to support the special-status plant species are not present in the Study Area;
- The Study Area is geographically isolated (e.g. below elevation, coastal environ) from the documented range of the special-status plant species;
- The historical landscape and/or habitat(s) of the Study Area were not suitable habitat prior to land/type conversion (e.g., reclaimed shoreline) to support the special-status plant species;
- Land use history and contemporary management (e.g., development, intensive grazing) has degraded the localized habitat necessary to support the special-status plant species.

The entirety of the Study Area is either developed land, subject to substantial historic soil disturbance, or is open water. These conditions are not suitable for special status plant species.

5.2.2 Special-status Wildlife

Of the 71 special-status wildlife species documented in the vicinity of the Study Area, most are upland species which are excluded from the Study Area based on a lack of habitat features due to development. Features not found within the Study Area that are required to support special-status wildlife species include:

- Vernal pools,
- Perennial freshwater aquatic habitat (e.g. streams or ponds)
- Marsh areas,
- Sandy beaches or alkaline flats,
- Presence of specific host plants,
- Caves, mine shafts, or abandoned buildings,
- Tall cliffs or rocky outcrops,
- Forest, and
- Offshore islands

The absence of such habitat features eliminates components critical to the survival, reproduction and movement of many special-status species often found in the vicinity. For instance, the absence of any salt marsh vegetation or tidal marsh habitat along the shoreline has eliminated the potential for marsh dwelling species such as California Ridgway's rail (*Rallus obsoletus obsoletus*), California black rail (*Laterallus jamaicensis coturniculus*), San Francisco common yellowthroat (*Geothlypis trichas sinuosa*), salt-marsh harvest mouse (*Reithrodontomys raviventris*), and salt marsh wandering shrew (*Sorex vagrans halicoetes*) to occur. The developed nature of uplands within and surrounding the Study Area also eliminates upland species-specific habitats such as: sandy beaches, wetlands, sand dunes or grasslands. Such habitats are required for species such as least tern (*Sternula antillarum browni*), or California red-legged frog (*Rana draytonii*). While marine mammal species such as humpback whale (*Megaptera novaeangliae*) and gray whale (*Eschrichtius robustus*) have been known to venture into San Francisco Bay and up to the Sacramento-San Joaquin Delta, those species do not regularly occur in the area and individuals of those species who were present in the area did so because they had become lost along their regular migratory paths. Species such as these are not considered further in this analysis.

Wildlife species with potential to occur in the Study Area are limited to birds, invertebrates, fish, and marine mammals. Following a background literature and database review, one bird species, 12 species of fish, and two species of aquatic mammals have potential to occur within the aquatic portions of the Study Area. These species are shown below in Table 2 and are discussed in greater detail below.

Table 2. Potential Special-status Wildlife

COMMON NAME	SCIENTIFIC NAME	CONSERVATION STATUS	POTENTIAL HABITAT IN THE STUDY AREA
FORMALLY LISTED WILDLIFE (FESA, CESA)			
bald eagle	*Haliaeetus leucocephalus*	FE, SE, CFP	**Assumed Present (foraging).** This species is not known to nest in the immediate vicinity but may occasionally forage within the Study Area's waters and shoreline.
Chinook salmon - Central Valley spring-run ESU	*Oncorhynchus tshawytscha*	FT, ST	**Seasonally Present.** This species is known to occur seasonally within San Pablo Bay as it migrates to and from natal streams at the northern end of the Sacramento Valley near Redding. Additionally, an experimental population of this species was introduced to the San Joaquin River. Natal and rearing streams are still far outside of the reach of the Study Area, but individuals may be present seasonally.
Chinook salmon – Sacramento winter-run ESU	*Oncorhynchus tshawytscha*	FE, SE, RP	**Seasonally Present.** This species is known to occur seasonally within San Pablo Bay and the Carquinez Strait as it seasonally migrates to and from spawning grounds in the Sacramento River.
Delta smelt	*Hypomesus transpacificus*	FT, SE, RP	**Incidentally Present.** This species home range is within Suisun Bay but is occasionally washed downstream into San Pablo Bay during large storm events. This species may be seasonally present in winter and early spring associated with high outflow years.
green sturgeon, southern Distinct Population Segment	*Acipenser medirostris*	FT, SSC	**Present.** This species is known to occur within the greater San Francisco Bay estuary year-round and during migrations to spawning grounds within the Feather and Sacramento Rivers.
longfin smelt	*Spirinchus thaleichthys*	FC, ST, SSC, RP	**Seasonally Present.** This species home range is from Suisun Bay to the southern end of San Francisco Bay. The species is present seasonally when moving between winter spawning grounds and summer areas.
steelhead - central CA coast DPS	*Oncorhynchus mykiss irideus*	FT	**Seasonally Present.** This species is known to occur within San Pablo Bay as it seasonally migrates to and from nearby spawning grounds in the Napa River and other nearby freshwater streams and rivers.
steelhead - central valley DPS	*Oncorhynchus mykiss irideus*	FT	**Seasonally Present.** This species is known to occur seasonally within San Pablo Bay as it migrates to and from natal streams located within the Sacramento Valley.
OTHER SPECIAL-STATUS WILDLIFE (SSC, MMPA)			
Chinook salmon - central valley fall/late fall-run ESU	*Oncorhynchus tshawytscha*	SSC, RP	**Seasonally Present.** This species is known to occur seasonally within San Pablo Bay as it migrates to and from natal streams located within the Napa River and further inland within

Table 2. Potential Special-status Wildlife

COMMON NAME	SCIENTIFIC NAME	CONSERVATION STATUS	POTENTIAL HABITAT IN THE STUDY AREA
			the Sacramento Valley.
Pacific lamprey	*Entosphenus (=Lampetra) tridentatus*	SSC	**Seasonally Present.** This species is known to occur seasonally within San Pablo Bay as it migrates to and from natal streams located within the Napa River and further inland within the Sacramento Valley.
river lamprey	*Lampetra ayresi*	SSC	**Seasonally Present.** This species is known to occur seasonally within San Pablo Bay as it migrates to and from natal streams located within the Napa River and further inland within the Sacramento Valley.
Sacramento splittail	*Pogonichthys macrolepidotus*	SSC, RP	**Seasonally Present.** This species is known to occur seasonally within San Pablo Bay as it migrates to and from natal streams located within the Napa River and further inland within the Sacramento Valley.
white sturgeon	*Acipenser transmontanus*	SSC	**Present.** This species occurs in San Pablo Bay year-round while foraging, or when migrating to and from natal streams located within the Sacramento Valley.
California sea lion	*Zalophus californianus*	MMPA	**Present.** This species is known to occur year-round in San Francisco Bay and may be present within San Pablo Bay especially during periods when migratory fish are present.
harbor seal	*Phoca vitulina*	MMPA	**Present.** This species is known to occur year-round in San Francisco Bay and may be present within San Pablo Bay especially during periods when migratory fish are present.
Status Abbreviations: FT- Federal Threatened FE – Federal Endangered FC – Federal Candidate ST – State Threatened			SE – State Endangered SSC – Species of Special Concern MMPA – Marine Mammal Protection Act RP – Recovery Plan

SPECIAL-STATUS FISH WITH POTENTIAL TO OCCUR IN THE STUDY AREA

Chinook salmon - Central Valley Spring-run ESU (*Oncorhynchus tshawytscha*), Federal Threatened, State Threatened.

The Central Valley Spring-run ESU includes all naturally spawned spring-run populations from the Sacramento San Joaquin River mainstem and its tributaries. Chinook salmon are anadromous (adults migrate from a marine environment into the fresh water streams and rivers of their birth) and semelparous (spawn only once and then die). Spring-run chinook salmon enter the Sacramento River between February and June. They move upstream and enter tributary streams from February through July, peaking in May-June. These fish migrate into the headwaters, hold in pools until they spawn, starting as early as mid-August and ending in mid-October, peaking in September. They are fairly faithful to the home streams in which they were spawned, using visual and chemical cues to locate these streams. While migrating and holding in the river, spring chinook do not feed, relying instead on stored body fat reserves for maintenance and gonadal maturation. Eggs are laid in large depressions (redds) hollowed out in gravel beds. Some fish remain in the stream until the following October and emigrate as "yearlings", usually with the onset of storms starting in October through the following March, peaking in November-December. Large pools with cold water are essential over-summering habitat for this species.

Within San Pablo Bay there are no spawning or freshwater rearing locations. This species occurs seasonally for short periods when migrating to natal streams in the spring, or when migrating to the ocean in late fall with the first rains.

Chinook salmon - Sacramento River Winter-run ESU (*Oncorhynchus tshawytscha*), Federal Endangered, State Endangered.

The ESU includes all naturally spawned populations of winter-run chinook salmon in the Sacramento River and its tributaries in California, as well as two artificial propagation programs: winter run chinook from the Livingston Stone National Fish Hatchery, and winter run chinook in a captive broodstock program maintained at Livingston Stone hatchery and the University of California Bodega Marine Laboratory. Winter-run chinook salmon are unique because they spawn during summer months when air temperatures usually approach their yearly maximum. As a result, these salmon require stream reaches with cold water sources that will protect embryos and juveniles from the warm ambient conditions in summer. Winter-run chinook salmon are primarily restricted to the mainstem Sacramento River.

Within San Pablo Bay and the Carquinez Strait, there are no spawning or freshwater rearing locations. This species occurs seasonally for short periods when migrating to natal streams in the winter or migrating to the ocean in spring and early summer.

Delta smelt (*Hypomesus transpacificus*), Federal Endangered, State Threatened.

Delta Smelt are a pelagic (live in the open water column away from the bottom) and euryhaline species (tolerant of a wide salinity range) found in brackish water. They are found only in the Sacramento-San Joaquin Estuary and as far upstream as the mouth of the American River on the Sacramento River and Mossdale on the San Joaquin River. They extend downstream as far as San Pablo Bay. During the late winter to early summer, delta smelt migrate to freshwater to spawn. Larvae hatch between 10-14 days, are planktonic (float with the water currents), and are washed downstream until they reach areas near the entrapment zone where salt and fresh water mix. Delta smelt are fast growing and short-lived with the majority of growth within the first 7 to 9 months of life. Most smelt die after spawning in the early spring although a few survive to a second year. Delta smelt feed entirely on small crustaceans (zooplankton).

Delta smelt are largely restricted to the Sacramento Delta proper, as well as the eastern portions of Suisun Bay. However, during large storm events when freshwater extends through the Carquinez Strait and into the greater portions of San Pablo Bay this species may either be washed downstream or migrate into the Napa River where a small number of fish have been documented. However, in areas around the Study Area this species is not known to spawn, rear or forage unless moving through the vicinity after being washed downstream during very intense winter storms which connect the Napa River with Suisun Bay creating suitable low salinity conditions.

Green sturgeon (*Acipenser medirostris*), Federal Threatened, CDFW Species of Special Concern.

Green sturgeon is generally found in marine waters from the Bering Sea to Ensenada, Mexico. However, spawning populations have been found only in medium-sized rivers from the Sacramento-San Joaquin system north. Spawning occurs in the Sacramento River between March and June; it may extend slightly longer, into July, in the Klamath River. Water temperature during spawning is likely 50° to 70°F. Spawning occurs in deep, fast water. The fertilized eggs are slightly adhesive and hatch after four to 12 days. Larvae stay close to the bottom and appear to rear primarily in rivers well upstream of estuaries. Young sturgeon (eight inches) feed primarily on small crustaceans such as amphipods and opossum shrimp. As they develop, they take a wider variety of benthic invertebrates, including various species of clams, crabs, and shrimp. Larger green sturgeon diet includes fish.

This species spawns only within the Sacramento and Feather Rivers. However, migrating individuals must pass through the Study Area in route to the ocean, and juveniles may spend several years rearing within San Francisco Bay, thus foraging juveniles are considered present throughout the year.

Longfin smelt (*Spirinchus thaleichthys*), Federal Candidate, State Threatened, CDFW Species of Special Concern.

Longfin Smelt is a pelagic, estuarine fish that ranges from Monterey Bay northward to Hinchinbrook Island, Prince William Sound Alaska. As this species matures in the fall, adults found throughout the San Francisco Bay migrate to brackish or freshwater in Suisun Bay, Montezuma Slough, and the lower reaches of the Sacramento and San Joaquin Rivers. Spawning is believed to take place in freshwater. In April and May, juveniles are believed to migrate downstream to San Pablo Bay. Juveniles tend to inhabit the middle and lower portions of the water column. This species tends to be abundant near freshwater outflow, where higher-quality nursery habitat occurs and potential feeding opportunities are greater.

This species is known to occur within San Pablo Bay seasonally and spawns within both Suisun Bay and the Napa River. While these areas are outside of the Study Area, fish may be present in the Study Area for much of the year during seasonal migrations.

Steelhead - Central California Coast DPS (*Oncorhynchus mykiss irideus*), Federal Threatened.

The Central California Coast DPS includes all naturally spawned populations of steelhead (and their progeny) in California streams from the Russian River to Aptos Creek, and the drainages of San Francisco and San Pablo Bays eastward to the Napa River (inclusive), excluding the Sacramento-San Joaquin River Basin. Steelhead typically migrate to marine waters after spending two years in freshwater, though they may stay up to seven. They then reside in marine waters for 2 or 3 years prior to returning to their natal stream to spawn as 4-or 5-year-olds. Steelhead adults typically spawn between December and June. In California, females typically spawn two times before they die. Preferred spawning habitat for steelhead is in perennial streams with cool to cold water temperatures, high dissolved oxygen levels and fast flowing water. Abundant riffle areas (shallow areas with gravel or cobble substrate) for spawning and deeper pools with sufficient riparian cover for rearing are necessary for successful breeding.

Tributaries of San Pablo Bay including the Napa River are natal streams for this DPS of steelhead. There are no spawning or freshwater rearing locations within or immediately surrounding the Study Area. This species occurs seasonally for short periods when migrating to natal streams in the winter or when migrating to the ocean in spring.

Steelhead - Central Valley DPS (*Oncorhynchus mykiss*), Federal Threatened.

The Central Valley DPS includes all naturally spawned populations (and their progeny) in the Sacramento and San Joaquin Rivers and their tributaries, excluding San Francisco and San Pablo bays and their tributaries. Preferred spawning habitat for steelhead is in perennial streams with cool to cold water temperatures, high dissolved oxygen levels and fast flowing water. During the winter or early spring the spawning fish reach suitable gravel riffles (shallow areas with gravel or cobble substrate) in the upper sections of streams and dig their redds. Abundant riffle areas for spawning and deeper pools with sufficient riparian cover for rearing are necessary for successful breeding. When steelhead spawn they nearly always return to the stream in which they were hatched. At that time they may weigh from two to twelve pounds or more.

Within San Pablo Bay and the Carquinez Strait, there are no spawning or freshwater rearing locations for this DPS of steelhead which are limited to spawning and rearing within the inland rivers of the Central Valley. However, this species occurs seasonally for short periods when migrating to natal streams in the fall and winter, or when migrating to the ocean in spring.

Chinook salmon - Central Valley Fall/late fall-run ESU (*Oncorhynchus tshawytscha*), NMFS Species of Concern, CDFG Species of Special Concern.

The Central Valley Fall/late fall-run ESU includes all naturally spawned spring-run populations from the Sacramento San Joaquin River mainstem and its tributaries. Late-fall run Chinook salmon are morphologically similar to spring-run chinook. They are large salmonids, reaching 75-100 cm SL and weighing up to 9-10 kg or more. The great majority of late-fall Chinook salmon appear to spawn in the mainstem of the Sacramento River, which they enter from October through February. Spawning occurs in January, February and March, although it may extend into April in some years. Eggs are laid in large depressions (redds) hollowed out in gravel beds. The embryos hatch following a 3-4 month incubation period and the alevins (sac-fry) remain in the gravel for another 2-3 weeks. Once their yolk sac is absorbed, the fry emerge and begin feeding on aquatic insects. All fry have emerged by early June. The juveniles hold in the river for nearly a year before moving out to sea the following December through March. Once in the ocean, salmon are largely piscivorous and grow rapidly. The specific habitat requirements of late-fall chinook have not been determined, but they are presumably similar to other Chinook salmon runs and fall within the range of the physical and chemical characteristics of the Sacramento River above Red Bluff.

Tributaries of San Pablo Bay including the Napa River are natal streams for fall-run chinook salmon, while late-fall run are limited to spawning within the main-stem of the Sacramento River or its more northern tributaries. There are no spawning or freshwater rearing streams for Late-fall run within or immediately surrounding the Study Area. This species would be expected to occur seasonally for short periods when migrating to natal streams in the fall as adults, or when migrating to the ocean in spring as juveniles or fry.

Pacific lamprey (*Entosphenus [=Lampetra] tridentatus*), Species of Special Concern.

This anadromous lamprey is found along the entire California coast with regularity until becoming disjunct south of San Luis Obispo County with the exception of regular runs to the

Santa Clara River (UCDAVIS 2016). With the exception of land-locked populations, this species spends the predatory phase of its life in the ocean, feeding off the bodily fluids of a variety of fish. This species is usually concentrated near the mouths of their spawning streams because its prey is most abundant in coastal areas (Moyle 2002). Adults move up into spawning streams between early March and late June. After hatching, ammocetes are washed downstream, where they burrow into soft substrates and filter feed. Five to seven years later, ammocetes undergo metamorphosis into the predatory phase of their life cycle, and out-migrate to the ocean as adults.

Tributaries of San Pablo Bay including the Napa River are natal streams for this species (Calfish 2023). There are no spawning or freshwater rearing locations within or immediately surrounding the Study Area. This species occurs seasonally for short periods when migrating to natal streams as adults or when migrating to the ocean as microphthalmia.

River lamprey (*Lampetra ayresi*), CDFW Species of Special Concern.

River lampreys prey upon a variety of fishes in the 10-30 cm TL size range, but the most common prey seem to be herring and salmon. Unlike other species of lamprey in California, river lampreys typically attach to the back of the host fish, above the lateral line, where they feed on muscle tissue. Little is known about habitat requirements in California, but presumably, the adults need clean, gravelly riffles in permanent streams for spawning, while the ammocetes require sandy backwaters or stream edges in which to bury themselves, where water quality is continuously high and temperatures do not exceed 25°C. Adults migrate back into fresh water in the fall and spawn during the winter or spring months in small tributary streams.

Tributaries of San Pablo Bay including the Napa River are natal streams for this species (Calfish 2023). There are no spawning or freshwater rearing locations within or immediately surrounding the Study Area. This species occurs seasonally for short periods when migrating to natal streams as adults or when migrating to the ocean as microphthalmia.

Sacramento splittail (*Pogonichthys macrolepidotus*), CDFW Species of Special Concern.

Splittail are primarily freshwater fish that have been found mostly in slow-moving sections of rivers and sloughs, and in the Delta and Suisun Marsh they seemed to congregate in dead-end sloughs (Moyle et al. 1982, Daniels and Moyle 1983). Splittail are benthic foragers that feed extensively on opossum shrimp (*Neomysis mercedis*). However, detrital material typically makes up a high percentage of their stomach contents. They will feed opportunistically on earthworms, clams, insect larvae, and other invertebrates. They are preyed upon by striped bass and other predatory fishes. Splittail apparently require flooded vegetation for spawning and as foraging areas for young, hence are found in habitat subject to periodic flooding during the breeding season (Caywood 1974).

Tributaries of San Pablo Bay including the Napa River are natal streams for this species (Calfish 2023). There are no spawning or freshwater rearing locations within or immediately surrounding the Study Area. This species may occur seasonally when foraging or moving between suitable habitats during high flow events in winter when salinities are suitable.

White sturgeon (*Acipenser transmontanus*), CDFW Species of Special Concern.

This sturgeon is found in most estuaries along the Pacific coast and are known to the San Francsico Bay Estuary. Adults in the San Francisco Bay Estuary system spawn in the Sacramento River and are not known to enter freshwater or non-tidal reaches of Estuary streams. White sturgeon typically spawn in May through June. The diet consists of crustaceans, mollusks, and some fish.

While the Study Area does not provide spawning habitat for any of the aforementioned species, waters of the Study Area at the junction of the Carquinez Strait, Mare Island Strait and San Pablo Bay support all of these species seasonally as they migrate between spawning and rearing habitats and the Pacific Ocean, or other areas of the greater San Francisco Bay region. Waters of the Study Area may support species as they temporarily forage and rear, but generally this area functions as migratory route for these species when moving between location.

White sturgeon spawn only within large rivers of the Sacramento Valley and not within the Napa River or in the local vicinity. Juveniles, however, may be present and forage within the surrounding bay waters year round.

SPECIAL-STATUS MARINE MAMMALS WITH POTENTIAL TO OCCUR

California sea lion (*Zalophus californianus*), MMPA.

California sea lions are found from Vancouver Island, British Columbia to the southern tip of Baja California in Mexico. They breed mainly on offshore islands, ranging from southern California's Channel Islands south to Mexico, although a few pups have been born on Año Nuevo and the Farallon Islands on the central Californian coast (TMMC 2023). Sandy beaches are preferred for haul out sites, although in California they haul out on marina docks as well as jetties and buoys (TMMC 2023).

Pacific harbor seal (*Phoca vitulina richardsi*), MMPA.

Harbor seals are fairly common, non-migratory pinnipeds inhabiting coastal and estuarine waters from Alaska to Baja California, Mexico. They are a year-round resident in the San Francisco Bay Area (Kopec 1999). They haul out on rocks, reefs, and beaches, and feed in marine, estuarine, and occasionally fresh waters (TMMC 2023).

Pacific harbor seal and California sea lion are both commonly found throughout much of San Francisco Bay, though they are less common in areas with more freshwater influence, such the Study Area and vicinity. Harbor Seals use open water for feeding and travelling, and terrestrial substrates such as beaches or small rocky islands adjacent to water for hauling out (resting). A haul-out site is generally considered a rookery if there are pups present at the site. Harbor seals in San Francisco Bay also tend strongly towards use of established haul-out areas, as opposed to hauling out in new areas (Kopec 1999). There are no beaches to haul out on and no known rookery sites within the Study Area or in the immediate vicinity. However, both of these species may be present opportunistically when foraging for fish in waters of the Study Area especially when adult salmonids migrate through the region in fall and winter or when following herring schools which return to San Francisco Bay in the winter.

Other marine mammals, such as humpback whales and gray whales have been documented to occur in the waters offshore of the Study Area on extremely rare occasions when individuals have strayed from their typical range. Because of the extreme infrequency with which other marine mammals have been observed in this area, they are not further considered individually in this analysis.

OTHER SPECIAL-STATUS SPECIES WITH THE POTENTIAL TO OCCUR IN AQUATIC AREAS

Bald eagle (*Haliaeetus leucocephalus*). Federal Eagle Protection Act, State Endangered, CDFW Fully Protected Species. The bald eagle occurs primarily as a winter visitor but also as a year-round (breeding) resident throughout most of California. Habitat is somewhat variable, but the species is usually strongly associated with larger bodies of water including lakes/reservoirs, major river systems, estuaries, and the ocean. Breeding occurs primarily in forested areas near water bodies; wintering habitat is more general, though standing water is usually present. The huge stick nests are typically placed in the upper portions of large, live trees that provide dominant views of surrounding areas (Buehler 2000). Fishes and waterfowl are usually favored prey, but a variety of live prey and carrion are consumed.

Upland areas that are adjacent to the Study Area lack any typical nest trees and are developed or adjacent to development, and as such are highly unlikely to be used for nesting. However, the Study Area and surrounds provide foraging habitat for this species in the form of bay waters (holding fishes and waterfowl) including shallower areas along the shoreline. While such foraging may occur occasionally throughout the year, foraging resources will not be impacted by project activities in any meaningful way given that large portions of the greater San Francisco Bay estuary and nearby waters (e.g., reservoirs) provide suitable foraging habitat and resources. Therefore, no potentially significant impacts to bald eagle foraging will result from project implementation and no mitigation measures or other actions are warranted.

5.3 Critical Habitat and Essential Fish Habitat

5.3.1 Critical Habitat

A review of the background literature showed that the Study Area is located within or adjacent to critical habitat for three special-status fish species:

- Central Valley Winter-run Chinook Salmon,
- Central California Coast steelhead, and
- Southern DPS Green Sturgeon.

In cases where critical habitat is within a bay or estuary, the extent of critical habitat is defined up to the HTL. The HTL is shown in Figure 5 (Appendix A) in relation to the proposed Project, and the extent of critical habitat is shown in Figure 7 (Appendix A).

Delta smelt critical habitat is present in close proximity to the Study Area but ends at the Carquinez Bridge. Therefore, the Study Area occurs next to, but is not within critical habitat for Delta smelt.

5.3.2 Essential Fish Habitat

A review of the background literature revealed that the Study Area is located within or adjacent to EFH for three fisheries management plans: Coastal Pelagic, Pacific Groundfish and Pacific Salmon.

- The Coastal Pelagic Fisheries Management Plan (PFMC 2021) is designed to protect habitat for migratory pelagic species such as Pacific sardine (*Sardinops sagax*), Pacific mackerel (*Scomber japonicus*), northern anchovy (*Engraulis mordax*), market squid (*Doryteuthis opalescens*), jack mackerel (*Trachurus symmetricus*) and various species of krill or euphausiids.
- The Groundfish Fisheries Management Plan (PFMC 2022a) is designed to protect habitat for approximately 80 species of fish, including various species of flatfish, rockfish, groundfish, and several species of sharks and skates.
- The Pacific Salmon Fisheries Management Plan (PFMC 2022b) is designed to protect habitat for commercially important salmonid species specifically Chinook and Coho salmon occur within the Study Area. While Coho salmon are extirpated from San Francisco Bay and its tributaries (NMFS 2012), Chinook Salmon would be seasonally present within waters surrounding the Study Area.

Similar to critical habitat discussed above, waters of the Study Area would be considered EFH up to the high tide line shown in Figure 5 (Appendix A).

5.4 Movement Corridors and Native Wildlife Nursery Sites

Wildlife movement between suitable habitat areas can occur via open space areas lacking substantial barriers. The terms “landscape linkage” and “wildlife corridor” are often used when referring to these areas. The key to a functioning corridor or linkage is that it connects two larger habitat blocks, also referred to as core habitat areas (Beier and Loe 1992; Soulé and Terbough 1999). It is useful to think of a “landscape linkage” as being valuable in a regional planning context, a broad scale mapping of natural habitat that functions to join two larger habitat blocks. The term “wildlife corridor” is useful in the context of smaller, local area planning, where wildlife movement may be facilitated by specific local biological habitats or passages and/or may be restricted by barriers to movement. Above all, wildlife corridors must link two areas of core habitat and should not direct wildlife to developed areas or areas that are otherwise void of core habitat (Hilty et al. 2019).

The aquatic portions of the Study Area function as a movement corridor for fish, including for the various special-status species discussed above. Salmonids for example will migrate through waters of the Study Area typically in late-spring or early summer when migrating to the Pacific Ocean as smolts/juveniles. Adults then migrate through the Study Area when returning to natal streams in fall or early winter. In the case of more regional species such as Delta or longfin smelt, they spawn in the Sacramento Delta and Suisun Bay, but make localized seasonal migrations to areas within San Francisco Bay. As such, the Study Area is situated between two core habitat areas (i.e., the Bay/ocean and freshwater spawning grounds) making it a migratory corridor. The Study Area does not provide a migratory corridor for species other than fish, because it does not provide for substantial connectivity between two core habitat areas for other classes of plants or wildlife.

Mapping efforts of submerged aquatic vegetation (SAV) within San Francisco Bay, as well as surveys by WRA within the Study Area have documented the presence of eelgrass beds (SFBSHGP 2023). Eelgrass is a habitat which serves as a spawning and nursery ground for various species such as Pacific herring. While eelgrass is present, the Study Area is at the inland extent of its range and its presence fluctuates yearly depending upon the salinity gradient created by delta outflow. As such, the extent and density of eelgrass varies from year to year. However, the presence of eelgrass beds means that these areas of aquatic habitat will serve as nursery sites for larval fish.

The Study Area does not function as a nursery site for other species such as egrets, herons, marine mammals, or as an overwintering site for Monarch butterflies. All such species require extensive trees for wind protection or roosting substrates, and no evidence of past occupation of the site has been documented, nor are any suitably protected groves present that might function as nursery sites for these species in the future. In addition, the highly developed shoreline is composed entirely of rip-rap. Sandy beaches, or islands typically used by marine mammals as haul outs or rookeries are not present. As such the only potential nursery sites are those within eelgrass beds.

6.0 Analytical Methodology and Significance Threshold Criteria

Pursuant to Appendix G, Section IV of the State CEQA Guidelines, a project would have a significant impact on biological resources if it would:

1. Have a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special-status species in local or regional plans, policies, or regulations, or by the CDFW or U.S. Fish and Wildlife Service;
2. Have a substantial adverse effect on any riparian habitat or other sensitive natural community identified in local or regional plans, policies, regulations, or by the CDFW or U.S. Fish and Wildlife Service;
3. Have a substantial adverse effect on state or federally protected wetlands (including, but not limited to, marsh, vernal pool, coastal, etc.) through direct removal, filling, hydrological interruption, or other means
4. Interfere substantially with the movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites;
5. Conflict with any local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance; and/or,
6. Conflict with the provisions of an adopted Habitat Conservation Plan, Natural Community Conservation Plan, or other approved local, regional, or state habitat conservation plan.

Because this report focuses on in-water elements of the project, the focus of the impacts and mitigation analysis is on Questions 1, 4, 5, and 6 above. Questions 2 and 3 have more bearing where projects occur on land. As stated above, this report is intended to only analyze those species with potential to occur within the aquatic communities of the Study Area. Therefore, the potential biological resources impacts and mitigation analysis included in this report is focused solely on aquatic areas. Potential impacts within terrestrial land covers are being addressed in the Project's EIR. For the purposes of this analysis, a "substantial adverse effect" is generally interpreted to mean that a potential impact could directly or indirectly affect the resiliency or presence of a local biological community or species population. Potential impacts to natural processes that support biological communities and special-status species populations that can produce similar effects are also considered potentially significant. Impacts to individuals of a species or small areas of existing biological communities may be considered less than significant if those impacts are speculative, beneficial, de minimis, and/or would not affect the resiliency of a local population.

7.0 IMPACTS AND MITIGATION EVALUATION

Using the CEQA analysis methodology outlined in Section 6.2 above, the following section describes potential significant impacts to sensitive resources within the Study Area as well as suggested mitigation measures which are expected to reduce impacts to less than significant.

A higher level of detail is available for Phase 1 project components at the time of this report than is available for Phases 2 and 3. Each project phase is evaluated commensurate with the level of detail available.

7.1 Special-status Species

This section analyzes the Project's potential impacts and mitigation for special-status species in reference to the significance threshold outlined in CEQA Appendix G, Part IV (a):

> *Does the project have the potential to have a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special-status species in local or regional plans, policies, or regulations, or by the CDFW or U.S. Fish and Wildlife Service?*

Potential impacts and mitigation for potentially significant impacts are discussed below for groups of species with relatively similar effects including fish, birds, and marine mammals. As discussed above, the Project occurs entirely in tidal waters and in shoreline areas that are developed or have a history of substantial disturbance from slope stabilization. Aquatic communities of the Project Area do not have the potential to support special status species plants; therefore, the analysis below focuses only on species with the potential to be present in aquatic areas. Potential impacts and mitigation for eelgrass and EFH are discussed in Section 7.2 (sensitive habitats).

7.1.1 Phase 1 Special Status Species Impacts and Mitigation

As described above, Phase 1 of the Project includes the new pier and associated reconfiguration of the existing boat basin.

GENERAL IN-WATER CONSTRUCTION IMPACTS TO SPECIAL STATUS SPECIES

Some potential impacts to special status species from in-water work are applicable to all aquatic special status species. This section reviews these impacts. Subsequent sections review potential impacts that apply differentially to special status fish, birds, and marine mammals.

Potential Impact BIO-1: Potential Introduction of Invasive Species

San Francisco Bay is one of the busiest ports in the world with more than 7,000 container ships per year entering the Bay (Choksi 2009). One consequence of such a robust trade network is the introduction of non-native species which are carried in ballast water of vessels or on ship hulls with bio-fouling. Introductions of non-native species to San Francisco Bay includes both fish and invertebrate species, which cause a variety of impacts to native fauna. Non-native species have a variety of deleterious effects from competing with or consuming native species (Moyle 2002), to decreasing pelagic productivity (Baumsteiger et al 2017). As a result of this impact and considering the danger that invasive species pose to native species and ecosystems, the U.S. Court of Appeals for the Ninth Circuit ruled that the U.S. Environmental Protection Agency must regulate ship discharges, including ballast water discharges containing invasive species, that pollute U.S. waters under the Clean Water Act (Choksi 2009). Further, Congress passed the Vessel Incidental Discharge Act, combining laws that regulate vessel discharge to help prevent the introduction of harmful species (Simmonds 2022).

Within aquatic environments, barges and boats used for construction are expected to be based in San Francisco Bay, therefore it is not expected that ships would bring in novel invasive species from other ports. However, if ships were to come into the Bay from outside, this may introduce non-native species. Any materials used for the Project will be new, but if aquatic equipment (e.g. pumps) are necessary and have not been properly cleaned and decontaminated, they could potentially spread invasive species.

Once in operation vessels using the pier and docks would be required to follow ballast water treatment procedures required by the U.S. Environmental Protection Agency (EPA) when those vessels are travelling to waters outside of San Francisco Bay and the central California coast. Following these regulations and would minimize the risk of introducing invasive species, however, the consequences of introducing new invasive species into San Francisco Bay can be very high. Therefore, the potential introduction of invasive species during construction and operations is a potentially significant impact to special-status fish and marine mammals.

The following mitigation measure will be implemented by the Proposed Project to reduce effects to less than significant levels.

Mitigation Measure BIO-1: Invasive Species Management

- Ships brought to the Project Area from ports outside of San Francisco Bay and Delta for aquatic construction or during operations shall follow all maritime regulations relating to the exchange of ballast water to prevent the spread of invasive species from outside ports.
- Any in-water fill materials such as piles or rock shall be new and not salvaged from areas outside of San Francisco Bay.
- Any pumps that may be needed during construction shall be cleaned and dried for at least 72 hours prior to being used on the Project.

With the implementation of Mitigation Measure BIO-1 effects from invasive species will be less than significant with mitigation incorporated.

Potential Impact BIO-2: Spills and Debris

In-water construction requires specialized mechanical equipment including vibratory or impact pile driving hammers, drilling equipment, tugboats, cranes, floating barges, and dredging equipment. These larger pieces of equipment require generators or compressors to run equipment, and a variety of petroleum and plant-based fuels or lubricants, many of which can be toxic to aquatic ecosystems if spilled and introduced accidentally. Similarly, debris from construction or demolition of in-water structures can enter the aquatic environment and may itself be contaminated with lubricants or preservatives. Introduction of such materials could cause degradation to the aquatic environment, including special-status fish and marine mammals, which is a potentially significant impact under CEQA.

Some elements of the proposed project would also require cast in place concrete for above-water structures, such as making connections between precast elements of the pier decking and the structural piles. Cast in place concrete when done over water can result in unintentional spilling of concrete into the water column. Exposure of raw concrete to the water column can result in changes to pH levels that can adversely affect fish, and at high enough concentrations, can lead to fish mortality. The amount of concrete that would be cast in place over the water is not anticipated to be sufficient to result in significant impacts to fish, particularly given the volume of water present in the work area. Further, no cast in place concrete is proposed within the water column.

The following mitigation measures will be implemented by the Proposed Project to reduce effects to less than significant levels.

Mitigation Measure BIO-2: In-water Work Window

- In-water work including the driving of piles and similar activities which require placing materials below the water's surface, will be completed between July 1 and November 30. Work may occur above the waterline year-round, including use of necessary in-water support vessels, so long as spill prevention measures are employed as described below. This in-water work window may be modified and extended if regulatory agencies determine during the permitting process that work outside of this window may occur without significant risk to fish.

Mitigation Measure BIO-3: Spill Prevention and Control

A spill prevention and control plan shall be developed and implemented for the proposed Project throughout all phases of construction. This plan will at minimum include the following parameters to reduce potential effects from spills to less than significant levels:

- Identification of any hazardous materials used by the Project.
- Storage locations and procedures for such materials.
- Spill prevention practices as well as BMPs employed for various activities.
- Requirements to inspect equipment daily such that it is maintained free of leaks.
- Spill kit location, cleanup, and notification procedures.

Mitigation Measure BIO-4: Environmental Awareness Training

A project-specific environmental awareness training for construction personnel shall be conducted by a qualified biologist before commencement of construction activities and as needed when new personnel begin work on the Proposed Project. The training shall inform all construction personnel about the presence of sensitive habitat types; potential for occurrence of special status fish and wildlife species; the need to avoid damage to suitable habitat and species harm, injury, or mortality; measures to avoid and minimize impacts to species and associated habitats; the conditions of relevant regulatory permits, and the possible penalties for not complying with these requirements. The training may consist of a pre-recorded presentation to be played for new personnel, a script prepared by the biologist and given by construction personnel trained by the biologist, or training administered by on-site biological monitors. The training shall include:

- Applicable State and federal laws, environmental regulations, proposed Project permit conditions, and penalties for non-compliance. A physical description of special-status species with potential to occur on or in the vicinity of the Proposed Project Site, avoidance and mitigation measures, and protocol for encountering such species including communication chain;
- BMPs enacted for habitat protection and their location on the Proposed Project Site including the implementation of any Spill or Leak Prevention Programs.
- Contractors shall be required to sign documentation stating that they have read, agree to, and understand the required avoidance measures. If they do not understand, they shall withhold their signature until the Designated Biologist addresses their question. The contractor may not begin work until they have signed the documentation.
- Field identification of any Proposed Project Site boundaries, egress points and routes to be used for work. Work shall not be conducted outside of the Proposed Project Site.
- A record of this training shall be maintained on the Project Site and shall be made available to agencies upon request.

Mitigation Measure BIO-5: Debris

The proposed Project shall employ debris, dust and garbage control measures to ensure disturbances to any upland areas, as well as overwater work does not result in turbidity, or debris being placed in the Bay.

- In areas within the boat basin where waters are less affected by high velocity currents, a debris boom or silt curtain shall be deployed around demolition sites, in addition to vessels or catchments used to catch demolition debris before it falls into the water.
- In areas exterior to the boat basin which are affected by high velocity currents, a debris boom or silt curtain may not be feasible during demolition and a work skiff or similar craft may be used instead of a debris boom to corral any debris which accidentally falls into waters during demolition. Debris

shall be retrieved immediately and will not be allowed to drift away from the worksite.

- Where cast in place concrete is required in over-water areas, the contractor shall use forms and catchments that will prevent concrete from falling into the water. Cast in place forms shall remain in place until concrete has completely cured and will be removed using means that minimizes dust and freshly cured concrete from falling into the water.
- Within upland areas, any disturbed soils shall be managed to prevent dust or silt laden runoff from becoming airborne or otherwise introduced to the aquatic environment.
- All personal construction related refuse will be collected in sealed containers and removed regularly.

With the implementation of Mitigation Measures BIO-2 through BIO-5 effects from spills and debris will be less than significant with mitigation incorporated.

Potential Impact BIO-3: Dredging Related Turbidity and Toxic Materials

Natural fluctuations in turbidity occur on a daily basis within the greater San Francisco Bay area. The naturally occurring light weight sediments that dominate the Bay and Sacramento-San Joquin Delta are easily mobilized during strong summer winds and storm related high flows, causing extreme spikes in turbidity, which can vary by several hundred nephelometric turbidity units (NTUs) even within a single day (O'Connor 1991). Elevated turbidity can impair gill function in fish, reduce oxygen availability in the water column, decrease physiological capabilities, and increase stress in fish (Heath 1995, Bash and Berman 2001). While turbidity can impact sensitive life stages of fish (i.e., eggs or larval fish), elevated turbidity alone does not represent a uniform impact to fish species. Delta smelt distribution has been positively correlated with higher turbidity which can help increase foraging efficiency and decrease predation threats (Sommer and Mejia 2013). Species present within the Bay and Delta are tolerant of these naturally occurring frequent large fluctuations in turbidity.

In-water work for Phase 1 elements such as installing or removing piles and dredging are expected to mobilize sediments which may contribute to increased water turbidity. Turbidity from pile removal and driving is likely to be limited to a small area (approximately 150-200 ft of the pile) and typically dissipate within one hour or would be swept away and diluted by tidal exchange (USFWS 2013). Thus, turbidity from pile driving activities is expected to be less than significant. However, turbidity associated with mechanical dredging typically spreads further due to the volume of bottom substrates that are disturbed. Studies of turbidity in San Francisco Bay showed that turbidity associated with dredging typically diminish to background levels within a radius of approximately 600 feet within one tidal cycle for singular events (Corps 2015). The actual distance suspended sediment caused by the Project would move is dependent upon multiple factors (i.e., tide, river outflows, wind condition, etc.) but the previous studies provide a guide under which we can determine potential effects. Turbidity caused by the Proposed Project may result in areas such as the shallow water habitat between the wharf and the shoreline, being temporarily unsuitable for fish. Considering the presence of other sensitive resources in the vicinity (e.g., eelgrass) impacts associated with dredging may cause sedimentation or die off of eelgrass or impacts to eggs or larval fish residing within eelgrass. In addition, previous maintenance dredging of the existing boat basin has identified copper and lead within the sediments. If these contaminants are still present, dredging could mobilize these materials, spreading them to areas that are currently not affected by elevated levels of these elements. These impacts would be considered potentially significant to special-status fish, marine mammals, and eelgrass beds under CEQA.

In addition to Mitigation Measures BIO-2 through BIO-5, the following mitigation measure will be implemented by the Proposed Project to reduce effects from dredging to less than significant levels.

Mitigation Measure BIO-6: Dredging

- Prior to dredging, sediment testing will be performed to determine whether elevated levels of any contaminant may be present within the dredging area. The results of this test will be submitted to the Dredge Material Management Office (DMMO) for review of the sediment contents, and for approval of sediment disposal methods or reuse suitability.
  - Materials will only be dredged and disposed of in accordance with procedures approved by the DMMO.
  - If concentrations are too high for beneficial reuse in upland restoration, or other standard dredge material disposal method, materials may be hauled to an approved hazardous waste disposal facility.
- Dredging shall be limited to the specified areas, depths, and quantities.
- No overflow or decant water shall be discharged from any barge at any time.
- During transportation from the dredging site to the disposal site, no dredged material shall be permitted to overflow, leak, or spill from barges, bins or dump scows.

With the implementation of Mitigation Measures BIO-2 through BIO-5, and Mitigation Measure BIO-6, effects from dredging will be less than significant with mitigation incorporated.

Potential Impact BIO-4: Creosote Pile Removal

During eelgrass surveys within the Study Area, several decaying former maritime structures were observed scattered throughout the Study Area. Former development along the shorelines of San Francisco and San Pablo Bay has left remnant maritime structures, especially pile complexes along many shorelines. Many of these structures are built using creosote treated timbers, a substance which delays decay of the wooden timbers, but is also toxic to fish and marine life (Werme et al 2010). Creosote timbers are also currently incorporated into the existing fender system along the Cal Maritime pier.

Removing creosote treated wood has been identified as a high priority for mitigation by the San Francisco Bay Institute as it provides benefits to the ecosystem by removing sources of toxin that spread beyond the footprint of the piles themselves (Werme et al 2010). However, improper removal of piles can result in the release of toxins into the local area which may affect fish and wildlife. Sediments disturbed and turbidity created through the removal process is expected to be minimal and dissipate as described above under Potential Impact BIO-2. Potential effects to critical life stages of fish (i.e. eggs or larvae) would also be avoided when timbers are removed during the in-water work window (Mitigation Measure BIO-1). However, if remnants of piles are not properly removed then the source of creosote would remain and potentially continue to release creosote into the aquatic environment. Given the toxic properties of creosote, such effects may be considered significant under CEQA to special-status fish and marine mammals if removal is not completed properly.

Mitigation Measure BIO-7: Creosote Pile Removal

- When removing creosote piles the contractor shall either fully remove the pile/structure, or piles may be cut off at least 1 foot below the mudline.
- Any fragments of wood which break off during the removal process will be collected immediately even if within the limits of a turbidity curtain.
- Any treated timber removed in this manner shall be hauled to an upland facility (i.e. landfill) which accepts treated timber waste for disposal.

With the implementation of Mitigation Measures BIO-2 through BIO-5, and Mitigation Measure BIO-7, effects from the removal of creosote piles will be less than significant with mitigation incorporated.

SPECIAL STATUS FISH SPECIES

Seven formally listed species, as well as five other special-status fish species are known to occur within the waters of San Pablo Bay. Formally listed species include Central California Coast steelhead, Central Valley steelhead, Spring-run Chinook, Winter-run Chinook, Southern Distinct Population Segment green sturgeon, longfin smelt, and Delta smelt. Special-status species which have not been formally listed include Fall/late-Fall run Chinook salmon, Pacific lamprey, river lamprey, Sacramento splittail and white sturgeon. All of these species make seasonal migrations through the Study Area and spend some portion of the year in the vicinity. No spawning habitats are known for any of these species within the Study Area.

Special-status fish species listed above have potential to occur in association with the open water portion of the Study Area. Many of the species are only present seasonally when salinity conditions are appropriate, or during migration periods. Those species seasonally present include all of the salmonids (all species of steelhead, and Chinook salmon), lamprey and smelts. Other species may forage within the waters of the Study Area year-round including green and white sturgeon, as well as Sacramento splittail.

Impacts to fish may occur in a variety of ways from a single construction related activity. For example, pile driving uses a hammer to set and drive structural components such as piles to support structures. Pile driving causes in-water sounds which can affect fish both physically and behaviorally. Construction equipment for such work also use hydraulically operated mechanical equipment which can pose potential for spills or accidents which may introduce toxic substances (i.e., fuel or hydraulic fluid) to the aquatic environment. Construction operations in general also have the potential to introduce debris and refuse associated with work to surrounding waters. Equipment and materials for such work are also highly specialized and may need to be brought in from other locations. The relocation of equipment may introduce non-native species of fish, or invertebrates, to the work area if proper procedures are not followed for decontamination. Most of these potential impacts affect a variety of species and so are discussed above and mitigated to a level that is less than significant by Mitigation Measures BIO-1 through BIO-7. Potential impacts to special status fish species resulting from pile driving and dredging activities are discussed in more detail below.

Potential Impact BIO-5: Underwater Noise and Pile Installation Impacts to Special Status Fish

Pile installation produces underwater noise, which manifests as pressure waves in the aquatic environment. The louder the noise, the more pressure is present in the waves. High pressure sound waves in the aquatic environment can result in damage to fishes' internal organs. The NMFS has established thresholds based upon the size of the fishes under consideration for the onset of physical injury and adverse behavioral effects. Those thresholds are listed below in Table 3 (NMFS 2018b). Because Delta smelt and longfin smelt are known to occur within the Study Area at certain times of the year, especially during their seasonal migrations in winter, the more conservative 183 dB SEL threshold is the effective criteria for hydroacoustic effects analysis for the Project. Behavioral modification is based on the root mean square (RMS) and is considered standard for all species. The RMS of 150 dB represents the zone where fish may be affected behaviorally but not physically harmed. However, it should be noted that in busy ports and bays such as San Pablo Bay, background underwater noise is frequently measured at or above 150 dB under baseline conditions, therefore the baseline noise conditions are frequently at or above the standard thresholds for behavioral effects (Caltrans 2020).

Table 3. Fish Impact Criteria

EFFECT	METRIC	FISH MASS (GRAMS)	THRESHOLD
Onset of physical injury	Peak pressure	N/A	206 dB (re: 1 μPa)
	Accumulated SEL	$\geq$ 2 g	187 dB (re: 1μPa^2•sec)
		< 2 g	183 dB (re: 1μPa^2•sec)
Adverse behavioral effects	RMS	N/A	150 dB (re: 1 μPa)

There are two primary styles in pile driving, vibratory and impact hammer driving. In some instances, rock anchors will be needed for piles and a different installtion technique will be utilized. These styles of pile driving/drilling have different potentials for effect and are described below.

Vibratory Pile Driving

Vibratory pile driving uses hydraulicly powered, oscillating counterbalance weights to vibrate an object (i.e., pile) at high speed. The vibration mobilizes the earth beneath and around the pile causing the surrounding earth to liquify. Once mobilized, the weight of the hammer pushes the pile downward. Vibratory hammers do not "strike" a pile and as such have lower peak sound pressure than impact hammers, but also require more prolonged use as they drive piles slower. Even with prolonged use, vibratory hammers do not approach the peak or cumulative sound exposure thresholds that would cause injury or death to fish (Caltrans 2020). Because of the low level of effect, resource agencies generally agree that vibratory pile driving results in reduced adverse effects on fish and is therefore the preferred driving methodology. This reduced level of effect is also why agencies have not identified any peak or cumulative injury thresholds for vibratory pile driving to fish (Caltrans 2020). With the lower level of effect, use of a vibratory hammer is often employed as an avoidance and minimization measure to reduce the overall number of strikes necessary to drive piles on a project. For this Project, removing any existing piles, or initially placing and driving new piles will be preferentially performed with a vibratory hammer to decrease the proposed Project's acoustic effect on the aquatic environment.

The limiting factors to driving with a vibratory hammer are seating depth and pile size. Small diameter piles (e.g., 18–24-inch steel pipe piles) or sheetpiles may be able to be fully driven using a vibratory hammer when substrates are soft (i.e., silty and low in clay). However, the presence of geotechnical conditions such as clay hardpans, especially when driving large diameter steel pipe piles to moderate depths, a vibratory hammer may not have sufficient energy to install the pile fully (Caltrans 2020). Once a vibratory hammer reaches refusal, an impact hammer is often necessary to complete the installation to drive piles to specified depths for structural integrity. Additionally, vibratory pile driving is often not able to achieve engineering criteria required to support design structural loads, and impact driving is necessary in these cases for "final seating" of the pile.

Impact Hammer Pile Driving

An impact hammer operates by using a sliding hammer head to strike a pile, causing the downward force of the head to drive the pile, similarly to the way a handheld hammer strikes and drives a nail. This method creates a pulse of sound that propagates through the pile, spreading outward into the aquatic environment. As shown in Table 3, peak, cumulative and RMS sound pressure levels all have different thresholds and types of effect. The "peak" is the highest value of the measured sound and may cause injury to fish exposed to instantaneous peak levels at or above 206 dB. Driving piles requires multiple strikes from the hammer, therefore there is also a cumulative effect of all strikes. In this case, cumulative exposure can cause injuries to fish at slightly lower decibel levels depending on the size of the fish. For fish less than 2 grams, the cumulative sound exposure level is 183 dB, while fish over 2 grams have a threshold of 187 dB. The distance at which these thresholds are reached vary based on the size and type of pile, number of strikes required, as well as the depth of water, and hammer size.

Bedrock Drilling

Following geotechnical exploration in 2023, some locations within the Project Area were identified as having bedrock near the surface, such that piles could not be driven without contacting bedrock. Piles cannot be driven into bed rock without compromising or destroying the pile beyond use, regardless of material. As such, piles to be located within bedrock material, referred to as "rock socketed piles", will also include rock anchors. Rock anchors are typically constructed by drilling small diameter holes within the pile casing, through soil and/or weak rock to competent rock using small/lightweight auger and/or downhole drill rigs. Depending on the design requirements, rock anchor drill holes will vary in diameter. While separated from surrounding waters by the pile casing, the drill holes are then tremie-filled with structural strength grout and reinforced steel strands or solid steel bars to form rock anchors. Once the grout has been fully cured, the rock anchors are then stressed to the required design loads and locked-off using bearing plates and anchor nuts which attach the anchors to the piles.

Rock socketed piles may also be constructed using larger diameter auger and/or rock core barrel drill rigs. Depending on the type of soil and/or weak rock and groundwater conditions, a temporary liner may be placed inside the pile casing, and used to support the upper soils and/or weak rock. Once the drill hole is into competent rock, the diameter of the drilled hole may be reduced and is often drilled without the need for temporary support systems such as a liner of support fluids. Depending on the design requirements, the length of the rock socket into competent rock can vary. Following drilling, structural strength concrete is tremied through the pile casing into the drill hole and the reinforcement steel pile is lowered into the drill hole, isolating the hole, and concrete from surrounding waters.

Geotechnical drilling of this nature produces non-impulsive sounds. As described above under vibratory pile driving, non-impulsive sounds do not have an injury threshold. Drilling of this type also creates non-impulsive noise in the range of approximately 155-160 dB, making the noise levels equivalent to that of vibratory pile driving examples shown in Table 5. As such, noise from bedrock drilling will have a less than significant effect. Further, any concrete or grout used to set the anchors or piles would be within bedrock or contained inside of the core of the pile. With concrete being contained in the bedrock or within the pile, it will not come into contact with the water column and negates potential effects associated with concrete entering water. As a result, the process of installation and materials used in these bedrock drilling procedures are expected to have a less than significant impact.

Phase 1 of the Project will require installation of a variety of pile sizes and types to support new pier and dock structures as well as provide docking and mooring support (Table 4). The general pile types identified in the plans for Phase 1 are shown below along with the likely material, size, and number of piles.

Table 4. Phase 1 Construction, Anticipated Pile Size and Type

PILE TYPE	PILE MATERIAL	PILE SIZE	NUMBER OF PILES ANTICIPATED (Maximum)
Elements to be Removed			
Pipe	steel	18-inch	58
Pipe	steel	24-inch	72
Fender	timber	12-inch	20
Sheetpile	steel	Width my vary	Approx 425 LF
Elements to be Installed			
Pipe	steel	42- inch	285
Guidepile	steel	18-inch	53
Sheetpile	steel	Width may vary	Approx 795 LF

Driving piles between July 1 and November 30 (during the in-water work window) will minimize the possibility that fish are present when work occurs as most special-status fish species are not likely to be present during this period. Even noise produced which might behaviorally affect fish would not be likely to impede important stages of migrations that might pass through the Carquinez Strait or Mare Island Strait in route to natal streams. During the in-water work window, more sensitive life stages (i.e., egg or larvae) are also not present, further reducing effects on these sensitive life stages. Sound levels shown below in Table 5 are examples of those effects which may be caused by the installation of piles of similar sizes described for Phase 1. All Projects referenced in Table 5 are from the Caltrans Technical Guidance for the Assessment of

Hydroacoustic Effects of Pile Driving on Fish (Caltrans 2020) or Illingworth & Rodkin (2017). All projects used no attenuation, therefore when calculating effects, addition of measures such as a bubble curtain or cushion block would reduce measured noise levels compared to the examples below.

Table 5. Reference Sound Measurements

PILE TYPE	PILE SIZE	HAMMER TYPE	REFERENCE PROJECT	WATER DEPTH (METERS)	DISTANCE (METERS)	RECORDED DECIBELS		
						Peak	*SEL*	*RMS*
Steel Shell	48 Inch	Impact	Navy East Coast Installations[1]	14	10	206	185	195
Steel Shell	48 Inch	Vibratory	Navy East Coast Installations[1]	8-11	10	-	-	159
Steel Shell	24 Inch	Impact	Amorco Wharf Repair	12	10	205	175	190
Steel Shell	24 Inch	Vibratory	Prichard Lake Pumping Station	3	10	181	153	153
Sheetpile	24 Inch	Impact	Napa River Flood Control Project	2-6	10	209	166	175
Sheetpile	24 Inch	Vibratory	Berth 23, Port Of Oakland	15	10	177	162	163

[1] Projects referenced from Illingworth and Rodkin 2017.

While most fish species are likely to be absent except during migratory periods, working during the recommended in-water work window would reduce impacts to most species, however, this window alone would not be sufficient in and of itself to reduce effects of pile driving to all fish as some may occur year-round. Therefore, pile driving may have significant impacts to fish unless mitigation measures are incorporated.

To reduce potential impacts to fish to a less-than-significant level, the following measures shall be implemented during any in-water work in addition to Mitigation Measures BIO-1 through BIO-7:

Mitigation Measure BIO-8: Pile Driving

Prior to initiation of construction, the CSU shall consult with regulatory agencies with jurisdiction over the project activities, such as CDFW, NMFS, and USFWS to obtain appropriate permits, and shall follow requirements of those permits. If permit requirements conflict with requirements below, the permit requirements shall take precedence. The following measures will be implemented during the driving of all piles to reduce any effects from pile driving to less than significant levels:

- In water work will be limited to the work window as stated in Minimization Measure BIO-2.
- Any wildlife encountered within the work area will be allowed to leave the area unharmed.

The following measures will also be included for times when work involves driving steel piles.

- To the extent possible, pile driving of steel piles will be conducted with a vibratory hammer.
- When installation with an impact hammer is required for steel piles, the following additional measures will be employed:
  - Use of a bubble curtain around steel piles.
  - Use of a slow start (gradually increasing energy and frequency) at the start of driving, or after a cessation of driving for more than 1 hour.
  - Underwater sound monitoring will be performed during pile driving activities. Sound monitoring will be completed for a minimum of 5% of each pile size and type utilized during construction to verify consistency with sound measurements of similar pile types and sizes documented for other projects. If sound measurements exceed those taken from similar pile types and sizes for other projects, additional sound attenuation measures, enhanced bubble curtains, or limiting pile strikes shall be implemented, and sound measurements shall be tested again to achieve sound levels similar to other projects.

With implementation of Mitigation Measures BIO-1 through BIO-7 and Mitigation Measure BIO-8, impacts to fish from in water construction would be less than significant with mitigation incorporated.

Potential Impact BIO-6: Shading

Overwater structures can alter underwater light conditions and result in a decrease in photosynthesis of diatoms, benthic algae, eelgrass and other aquatic organisms. This decrease in primary productivity can then lead to a decrease in prey items for fish and higher trophic levels (Nightingale and Simenstad 2001). Additionally, invertebrates, fish, and aquatic plant occurrences under overwater structures have been found to be limited when compared to unshaded and vegetated habitat (Nightingale and Simenstad 2001, Thayer et al 1984). Light conditions under the pier and trestle are currently such that no light can penetrate the surface at any point. Phase 1 of the proposed project will increase the area of over-water shading compared to existing conditions, with a maximum net increase of approximately 29,681 sq. ft., as shown in Table 6 below. Maximum net increase values are calculated based on the trestle replacement option. Shade increases may decrease primary productivity of the area by limiting light to diatoms, algae or other primary producers, thereby impacting habitat quality and suitability for fish species. Without mitigation, the loss of habitat function may be considered a significant impact to special status fish, marine mammals, and eelgrass beds under CEQA.

Table 6. Shade Footprint for Phase 1

PROJECT ELEMENT	EXISTING OVERWATER COVERAGE (sf)	PROPOSED OVERWATER COVERAGE (sf)	NET CHANGE (sf)
Pier (including fenders)	8,031 (to be removed)	22,968	14,937

Trestle	3,199	4,700[2]	1,501[2]
Catwalk	0	619	619
Breakwater (daylit portion)	898 (to be retained)	1,877	979
Floating Docks and Gangways	3,192	7,299	4,107
Transition Pier	0	1,200	1,200
Mooring Dolphin	567 (to be removed)	6,413	5,846
Utility Rack	0	492	492
Total	15,887	48,767	29,681

Mitigation Measure BIO-9: Mitigation for Shading of Open Waters

Where possible, the Project will install light-transmitting surfaces allowing for a minimum of 40% light transmission to the waters below. In the event light-transmitting surfaces cannot be installed for safety and accessibility reasons, the Project will mitigate for shading and lost aquatic resource function by one of the following means:

- Removing equivalent shaded coverage over open water at a nearby site,
- With the purchase of appropriate mitigation credits from an approved mitigation bank at a (1:1 ratio), or
- By other similar actions approved by regulatory agencies during the consultation process described in Mitigation Measure BIO-8, so long as those alternative actions achieve a similar effect as described above (e.g., construction of a restoration project which causes ecological uplift of habitat quality).

With the implementation of Mitigation Measure BIO-9, adverse effects due to shading of open waters will be reduced to less than significant.

Potential Impact BIO-7: Fish Entrainment During Dredging

The proposed Project would dredge material from within the existing boat basin (approximately 60,000 cubic yards), to prepare the area for installation of various Phase 1 elements. Dredging has the potential to entrain fish during the process when collecting bottom sediments. Life stages which are immobile such as eggs and larvae are the most susceptible to dredging and are more likely to be entrained due to their inability to self-relocate (Wenger et al 2017). However, as stated above there are no spawning beds for any species within the Study Area as it does not

[2] Should the trestle be replaced, this represents its maximum footprint. Proposed overwater values for the trestle would remain unchanged if the trestle is to remain. Mitigation measures described for shade impacts would be applicable for either scenario and would ultimately reduce effects to less than significant levels irrespective of the trestle approach.

contain freshwater streams or substrates required for any of the anadromous species and aquatic vegetation is limited. There is eelgrass present when salinity conditions are suitable, and such vegetation can support spawning by Pacific herring or similar species. General impacts to eelgrass are discussed below in Section 7.2 in more detail. However Pacific herring, like many migratory fish spawn in December – March, outside of any period when dredging or in-water work would occur as restricted in Mitigation Measure BIO-2. Therefore, dredging would not occur at a time of year when the most susceptible life stages of fish are present. Further, dredging would be limited to using clamshell or mechanical dredging which is far less likely to entrain fish than suction or hopper dredging (Reine 1998). Clamshell dredging is often used as the preferred alternative due to the lower likelihood of entrainment and when conducted during the summer and fall when in-water work is allowed, limits dredging to the times of year when most species are seasonally absent. If fish are present, they are fully mobile juveniles or adults which are able to avoid areas of disturbance associated with dredging. Further, dredging within San Francisco Bay is managed by the DMMO. For DMMO authorized dredging within this portion of San Pablo Bay, it is recommended that any dredging occur from July 1 to November 30 to correspond to the period of time when impacts to species are less significant .

The combination of adherence to in-water work windows and the use of mechanical dredging methods reduce the potential for entrainment of special status fish species during dredging to a level that is less than significant. Therefore, implementation of Mitigation Measures BIO-1 through BIO-6 would reduce effects of dredging on fish to less than significant levels.

CRITICAL HABITAT

Critical habitat within this portion of San Pablo Bay is present for central valley winter-run chinook salmon, central California coast steelhead, and southern DPS green sturgeon. For all three species the Project Area functions as an estuarine corridor, the primary function being to promote movement of species from freshwater spawning areas to the Pacific Ocean and back.

Phase 1 does not create an aquatic net, trap or barrier that might impede fish movement. The linear pier and breakwater are permeable to water and fish movement in multiple locations such that a fish may move around these objects easily, without risk of being trapped behind an impermeable breakwater. As such the new structures of Phase 1 do not represent a significant barrier that would cause a cessation to movement, or significant delay for migrating fish and is less than significant. Other potential impacts to critical habitat for these species are mitigated through the implementation of Mitigation Measures BIO-1 through BIO-9.

SPECIAL STATUS BIRD SPECIES

The proposed Project has the potential to impact native nesting birds. No special-status birds are likely to nest within the fully developed shoreline, or on the extant wharf due to the highly modified and developed nature of the active marine facility. These features do not contain specialized habitats such as salt marsh or sandy shoals which might support special-status nesting birds found in the vicinity. However, non-special-status nesting birds protected by the Migratory Bird treaty Act as well as the California Fish and Game Code may nest on or near these structures and be affected by construction related activities if construction occurs during the nesting season. Non-special-status birds may vary in size and species from small passerines such as black phoebe (*Sayornis nigricans*) to larger and more charismatic raptors such as osprey (*Pandion haliaetus*). All such species could be affected similarly through noise, vibratory or visual disturbance, and have similar nesting bird survey protocols to identify nesting locations. Therefore, these species are addressed collectively below.

Potential Impact BIO-8: Nesting Birds

Non-special status birds may nest on buildings, structures or within limited vegetation within the Study Area between February 1 and August 31. Project activities during this time may directly remove or destroy active nests, or may indirectly cause nest abandonment through audible, vibratory, and/or visual disturbances. Loss of active nests due to activities of the project would be considered a significant impact under CEQA.

To reduce potential impacts to nesting birds to a less-than-significant level, the following measures shall be implemented:

> **Mitigation Measure BIO-10: Nesting Birds**
>
> If construction is initiated outside of the nesting season, between September 1 and January 31, birds are unlikely to be nesting and work would not result in significant impacts to nesting birds. However, should work be initiated during the nesting season (February 1 to August 31), a pre-construction nesting bird survey shall be conducted by a qualified biologist no more than 14 days prior to the start of construction activities. The survey shall cover all areas within 500 feet of planned construction activities. Should an active nest be identified, a high visibility "No disturbance" buffer shall be established by the qualified biologist within the upland areas. Work within aquatic areas will be provided a map outlining the buffer but due to the need to maintain an open, navigable waterway, buoys, signs or similar temporary structures will not be placed in the water to denote the buffer. The buffer distance shall be based upon the species and location of the nest, potential for construction noise, vibration, visual disturbance, or other disruptive metrics to reach and affect nesting.
>
> The buffer shall be maintained until it can be verified by a qualified biologist that the nestlings have fledged, or the nest has failed. Should construction activities cease for 14 or more consecutive days during the nesting season (February 1 – August 31), an additional nesting bird survey shall be conducted prior to resuming construction.

With implementation of Mitigation Measure BIO-9, impacts to nesting birds would be less than significant with mitigation incorporated.

MARINE MAMMALS

Marine mammals are known to occur within San Pablo Bay including harbor seals (*Phoca vitulina*) and California sea lion (*Zalophus californianus*). Both species are known to occur in the vicinity of the Study Area primarily when migrating through the waters of the Study Area or the adjacent Carquinez Strait during seasonal periods, often following returning salmon, or when foraging for other fish species. No islands or sandy beaches are present within the Study Area or immediately adjacent that might support haul-outs, colony basking sites or breeding grounds for marine mammals. The shoreline of Cal Maritime is heavily armored with rip rap, making it unsuitable for use by seals and sea lions. Most commonly, marine mammals are observed in this area foraging or moving through open waters in route to other locations where haul-outs, rookeries or similar sites of aggregation are known. Given the lack of suitable haul-out locations, and no known colony locations, a small number of individual marine mammals may be present while moving through or foraging within the Study Area. Potential impacts to marine mammals in addition to Impacts BIO-1 through BIO-4 (potential impacts which may affect all species) are discussed in more detail below.

Potential Impact BIO-9: Noise Impacts to Marine Mammals

Similarly to fish, marine mammals can be injured if sounds produced by construction related activities surpass certain tolerances. Injury to marine mammals from noise relates primarily to hearing damage or loss, and the thresholds for injury differ from those established for fish. The NMFS thresholds for Post-Traumatic Stress (PTS) onset of pinnipeds vary by group and by the type of sound (peak vs cumulative) (implusive vs non-impulsive). The values established by NMFS pile for injury to marine mammals from pile driving are provided in the table below. Different pile driving methods produce different types of sounds (impulsive sounds [i.e., impact hammers] vs non-impulsive sounds [i.e., vibratory hammers]), and so they have different potential for effects (NMFS 2018). In this case the marine mammals most likely to occur in the Study Area are harbor seals and California sea lions, their onset PTS threshold in dB is shown in Table 7.

Table 7. NMFS Threshold Criteria for Select Marine Mammals

HEARING GROUP	PTS ONSET		BEHAVIOR
	Peak (dB)	*Cumulative (dB)*	
Phocid Pinnipeds (Seals)	218	185	160
Otariid Pinnipeds (Sea Lions)	232	203	160

To determine if pile driving has the potential to surpass these thresholds, NMFS has developed a calculator (NMFS 2022) which allows biologists to model the distance at which thresholds for pinnipeds and other wildlife may be met or exceeded. Calculations require reference data (Table 4) as well as the extent of use of each hammer type per day, and accounting for any attenuation (i.e., a manner of driving, or device used to decrease sounds created when pile driving). In this case we assumed up to 6,000 strikes per day from an impact hammer, or up to 360 minutes (6 hours) of driving using a vibratory hammer to represent the maximum impact in one day. The results are shown below in Table 7 separated by pile type, hammer type, and daily use. These are extremely conservative (high end) estimates for productivity during construction and so represent a worse case scenario for potential project impacts.

Table 8. Distances to Marine Mammal Onset PTS by Pile and Hammer Type

PILE MATERIAL	PILE SIZE	HAMMER TYPE	HAMMER STRIKES PER DAY (IMPACT) OR DRIVE TIME PER DAY (VIBRATORY)	BUFFER DISTANCE (FEET)
Steel shell[1]	48-inch	Impact	6,000 strikes	3,650
Steel shell	48-inch	Vibratory	360 minutes	50
Steel shell	24-inch	Impact	6,000 strikes	1,750
Steel shell	24-inch	Vibratory	360 minutes	20
Sheetpile[1]	-	Impact	6,000 strikes	425
Sheetpile	-	Vibratory	360 minutes	95

[1] Piles referenced in Table 4 did not use attenuation. For this calculation it is assumed a bubble curtain would be deployed to reduce the overall decibels by 5 resulting in the following buffer distances.

In this case even small steel piles shown above have the potential to exceed onset PTS thresholds noted for pinnipeds at relatively short distances. Without incorporation of mitigation measures, sounds produced from pile driving would be expected to cause behavioral and potentially onset of PTS to marine mammals. These impacts would be considered significant under CEQA.

Mitigation Measure BIO-11: Marine Mammals

In addition to implementation of Mitigation Measure BIO-8: Pile Driving, the project shall implement the following additional measures to reduce impacts to marine mammals from in-water construction.

- The proposed Project shall consult with NMFS to obtain a marine mammal harassment authorization for any potential Project related harassment of marine mammals.
- During all construction work where materials are being actively placed below the water line, a marine mammal monitor shall be present to observe and document marine mammal presence.
- During pile driving, if a marine mammal is within the buffer distance shown in Table 8, or within distances approved by NMFS based on future updated construction drawings and contractor input, the marine mammal monitor will inform the construction crew and work will temporarily halt until the animal has passed outside of the disturbance buffer.

With implementation of Mitigation Measure BIO-8 and Mitigation Measure BIO-11, impacts to marine mammals would be less than significant with mitigation incorporated.

Potential Impact BIO-10: Ship Traffic Impacts to Marine Mammals

The proposed Project occurs along the shores of Morrow Cove and San Pablo Bay, within an area already developed with marina facilities with a boat basin that supports various small craft as well as Cal Maritimes training operations including the TSGB.

Morrow Cove and the Carquinez Strait are a highly trafficked and developed waterway supporting numerous private industrial and recreational facilities. Industrial operations which are commonly serviced by large ships include the Shell Martinez Oil Refinery, Crocket Cogeneration, and the Mare Island Dry Docks. In addition, industrial ports further inland within California's central valley include the Ports of Stockton and West Sacramento. The Port of Stockton supports between 230 and 300 industrial ships per year, and when combined with the Port of Sacramento, service more than 350 ships per year (Port of Stockton 2022). Additionally, the current boat basin supports approximately 10-15 small vessels, along with a boathouse that supports additional vessels. Given the level of traffic at these various operations and ports which must pass through or travel adjacent to the Study Area, the waters surrounding the Study Area are already highly disturbed by large vessel traffic and the extant boat basin is operating near maximum capacity, with 10-20 vessels at any given time.

As such, replacement of the TSGB with NGSV as well as reorganization of Boat Basin 1 is not anticipated to significantly change extant conditions. All vessels will continue to operate in the extant limits of Boat Basin 1 and the number of slips will be increased from 10 to 23 to accommodate the number of currently operational vessels more readily. Phase 1 of the project would not result in significant impacts to marine mammals from ship traffic compared to baseline conditions.

7.1.2 Phase 2 and 3 Special Status Species Impacts and Mitigation

Elements of Phases 2 and 3 include:

- Upgrades to the existing boathouse,
- A new boat basin to the west of the existing boat basin, including a breakwater and installation of slips for small vessels
- Dredging for new boat basin
- Expansion of the existing marine yard, including construction of future laboratory facilities
- Replacement of existing temporary storage facilities with permanent buildings
- Installation of a hydrokinetic barge
- Construction of a new multi-story row house, and
- Creation of new shoreline intertidal improvements including a living reef.

The majority of potential impacts to special status species resulting from implementation of Phases 2 and 3 would be the same as those from Phase 1, including:

- **Potential Impact BIO-1:** Potential Introduction of Invasive Species
- **Potential Impact BIO-2:** Spills and Debris
- **Potential Impact BIO-3:** Dredging Related Turbidity and Toxic Materials
- **Potential Impact BIO-4:** Creosote Pile Removal
- **Potential Impact BIO-5:** Underwater Noise and Pile Driving Impacts to Special Status Fish
- **Potential Impact BIO-6**: Shading
- **Potential Impact BIO-7:** Fish Entrainment During Dredging
- **Potential Impact BIO-8:** Nesting Birds
- **Potential Impact BIO-9:** Noise Impacts to Marine Mammals
- **Potential Impact BIO-10:** Ship Traffic Impacts to Marine Mammals

Impacts and mitigation measures from Phase 1 shall apply to Phases 2 and 3, and would mitigate potential impacts to special status species from Phase 2 and 3 activities to a level that is less than significant.

SPECIAL STATUS FISH SPECIES

Phase 2 and 3 are anticipated to have similar effects to special status fish as would occur from Phase 1, including:

- Threats due to introduction of invasive species;
- Toxic conditions from spills or debris;
- Disruption of bottom sediments and spreading of contaminated sediments;
- Remnant toxicity from creosote piles;
- Potential to directly injure fish; and
- Potential to disrupt migratory events;

These threats would be mitigated by implementation of Mitigation Measures BIO-2 through BIO-9, which will ensure construction related activities occur at the times of year when fish are less likely to be present, and that proper precautions and planning is enacted to educate workers and ensure the Project is implemented as described to avoid deleterious effects such as toxic spills or lingering effects from creosote. Other threats to fish and aquatic life associated with introduction of novel invasive species are addressed both during construction and during operation by the implementation of Mitigation Measure BIO-1.

Phases 2 and 3 would increase shading of existing open water to a greater extent than would Phase 1, potentially more than doubling the area of over-water cover compared to existing conditions. That increase in over water cover would be a significant impact to special status fish species. Potential Impact BIO-6 (Shading) identifies this potential impact from Phase 1 and would apply to Phases 2 and 3 as well. Mitigation Measure BIO-9 would mitigate potential impacts from over-water shading in Phases 2 and 3 to a less than significant level.

Phases 2 and 3 also involve shoreline work to create a resilient, interactive, and more ecologically focused shoreline, as well as in-water work to create a living shoreline. These project elements would result in an overall net benefit to special status fish species. Construction of these beneficial elements would result in potential impacts to special status fish of the same type identified for Phase 1 in Potential Impact BIO-1 through BIO-7, and mitigated by Mitigation Measures BIO-1 through BIO-9. While these future elements are varied and occur over a prolonged period of time, the impacts remain similar and would be similarly reduced to less than significant levels with continued application of the Mitigation Measures prescribed for Phase 1.

One element of Phase 3, installation and operation of the hydrokinetic barge is a novel element and requires further review for potential impacts to special status fish species.

Potential Impact BIO-11: Hydrokinetic Barge Operation

The hydrokinetic barge is envisioned as an on-site energy generation facility. While the specific design and operations of the hydrokinetic barges is not known at this time, it is anticipated that this system could operate similarly to other aquatic based electric generation, via a turbine which is driven by the movement of water. As the turbine rotates from the natural movement of water, a generator could be powered to create electricity. The turbine could be turned via rotating surface paddles, or directly from wave and currents below the waterline. In both cases, flow of water across the turbine blade or paddle, drives a generator which produces electricity. That electricity is then sent via a transmission line back to the shore and into the power grid. If water is drawn across a turbine, it is possible that fish or other wildlife may be forced through the turbine, which can cause injury or death. Such effects to fish and habitats would be considered a significant effect under CEQA.

Mitigation Measure BIO-12: Hydrokinetic Barge

Prior to installation and operation of the barge, a qualified biologist will review the proposed design and operation of the hydrokinetic barge to determine if operation of the barge is likely to cause take of fish or if the operation will impact sensitive habitats. The qualified biologist will compose a memo outlining anticipated operational procedures and will review any potential impacts to fish and habitats, along with recommendations to modify the proposed operation to minimize any such impacts to less than significant levels (if necessary). Such recommendations may include:

- Take permits under California Fish and Game Code and the federal Endangered Species Act shall be obtained prior to installation and operation of any hydrokinetic barge system with the potential to harass, injure or kill listed fish or other listed aquatic species.
- Measures to isolate the turbine and other moving parts from the aquatic environment (such screening) shall be required to avoid and minimize potential impacts to listed species.
- Noise modeling shall be completed for hydrokinetic barge operation and the results compared to thresholds for noise effects to fish and marine mammals described in Table 3 and Table 7. Measures to minimize significant noise impacts to listed species and marine mammals shall be incorporated into the hydrokinetic barge design.
- Stationing the barge over water of sufficient depth that it is unlikely to support eelgrass or other submerged aquatic vegetation.
- Obtaining additional mitigation credits for shading open waters and eelgrass.
- Seasonal operation of the barge to limit the potential for special-status fish to be injured.

After a review and any recommendations are compiled, the report shall be submitted to CDFW, USFWS, and NMFS for review to ensure that installation and operation of the barge with any adaptive recommendations will sufficiently reduce effects of installation and operation of the barge to less than significant levels.

Implementation of Mitigation Measure BIO-12, in addition to Mitigation Measures BIO-1 through BIO-9 would reduce potential impacts from the hydrokinetic barge installation and operation to a level that is less than significant for this Phase 3 element.

CRITICAL HABITAT

Elements in Phase 2 and 3 would expand upon the footprint of developed areas within San Pablo Bay, increasing the area of over water cover in the area. As described above for Phase 1, critical habitat within this portion of San Pablo Bay functions as an estuarine corridor, promoting movement of species from freshwater spawning areas to the Pacific Ocean and back. Potential impacts of Phases 2 and 3 to migratory corridors are described below in more detail in Section 7.4, which includes an impact and mitigation measure to manage risk to migratory corridors from construction of these future phases.

While Phases 2 and 3 would potentially more than double the area of over water cover present compared to existing conditions, they would not create an aquatic net, trap or barrier that might impede fish movement and the essential habitat function of the Project Area would remain intact. Potential impacts to critical habitat from construction and operations of Phases 2 and 3 are identified and mitigated to a level that is less than significant by Mitigation Measures BIO-1 through BIO-9, as well as Mitigation Measure BIO-12.

SPECIAL STATUS BIRD SPECIES

Implementation of elements described in Phases 2 and 3 of the Project Description will include more shoreside elements than Phase 1 including:

- Upgrades to the Boathouse,
- Building a new Boathouse for Basin 2,
- Expansion of the Marine Yard,
- Upgrades to the Rowhouse, and
- Replacement of Marine Program trailers with permanent buildings.

These elements will continue to be within the developed shoreline and developed landscapes of the Cal Maritime Campus. The extent of elements for Phases 2 and 3 are shown in the overall concept Figure 3 (Appendix A).

The general location along the shoreline means that there continues to be potential for the proposed Project to impact nesting birds that may nest along the shoreline, whether that be within trees, or on buildings of the campus. Construction elements whether driving piles which create, audible, visual and vibratory disturbance, or construction of buildings and operation of general equipment will also continue to be similar and will have similar potential to affect nesting birds. Habitat elements remain largely the same as Phase 1 and areas of specialized habitat such as salt marsh or sandy shoals are still absent, therefore no shift in potential bird species composition is expected to occur. Non-special status native nesting birds would still comprise those species which may be affected by future Phases of the Proposed Project. As such, continued implementation of Mitigation Measure BIO-9: Nesting Birds during future Phases 2 and 3 would continue to provide protection to nesting birds, such that any potential impacts during future Phases would be reduced to less than significant levels.

MARINE MAMMALS

In- or over-water structures in Phases 2 and 3 such as the boathouse for Basin 2, row house and living reefs described will all require in water construction to support the new buildings or structures. Habitat elements remain similar to those of Phase 1 and marine mammal haul outs are still absent, but individual animals may still be present. All in-water construction activities of Phase 2 and 3 would therefore have similar potential to impact marine mammals. As such, continued implementation of Mitigation Measures BIO-8 during Phases 2 and 3 would continue to provide protection to marine mammals such that any impacts during future Phases would also be reduced to less than significant levels.

Phases 2 and 3 propose to more than double the number of new small vessel slips to accommodate an expanded maritime training program. This would increase the amount of small and medium sized vessel traffic both in harboring and operating vessels beyond the baseline conditions. Local marinas provide docking for hundreds of small vessels in the vicinity of the Study Area including:

- Glen Cove Marina and Yacht Club: 200+ vessel slips,
- Benicia Marina: 300+ vessel slips,
- Vallejo Yacht Harbor 200+ vessel slips, and
- Vallejo Municipal Marina: 300+ vessel slips.

As such, the addition of new facilities for Boat Basin 2 would increase the number of small vessel slips in the vicinity of the Study Area by less than 3 percent, and this is not considering the abundant vessel traffic present within the major Sacramento-Stockton Deepwater Shipping Channel directly adjacent to the Project Area. Though the number of vessels is expected to increase, it is by an extremely small amount when considered in the context of vessel traffic within the vicinity. As such, impacts to marine mammals from ship traffic in Phases 2 and 3 are expected to be less than significant.

Impacts by the proposed Project to marine mammals associated with Phases 2 and 3 would be limited to noise and disturbance associated with construction. As discussed above, project elements including the installation of piles to support the new buildings in Phases 2 and 3 may create noise sufficient to cause harassment or PTS to marine mammals. These impacts would be considered significant under CEQA if left unmitigated. However, implementation of Mitigation Measures BIO-8: Pile Driving and Mitigation Measure BIO-11: Marine Mammals would similarly reduce impacts to less than significant levels.

7.2 Sensitive Natural Communities and Land Cover Types

This section addresses the question:

> *b) Does the Project have a substantial adverse effect on any riparian habitat or other sensitive natural community identified in local or regional plans, policies, regulations, or by the CDFW or U.S. Fish and Wildlife Service;*

The Study Area is located within EFH for three fisheries management plans: Coastal Pelagic, Pacific Groundfish and Pacific Salmon. EFH consists of aquatic areas that contain habitat essential to the long-term survival and health of fisheries, which may include the water column, certain bottom types (e.g., rocky reefs), vegetation (e.g., eelgrass beds), or complex structures such as oyster beds. Within the Study Area, the majority of benthic substrates consist of silt and mudflat. These areas are typical low-productivity areas which are more commonly traversed by migratory species. The absence of any reefs, freshwater streams or similar complex habitat features make this area important primarily as a migratory corridor, allowing EFH species to move from place to place. As discussed with regard to Critical Habitat (above) and in Section 7.4 (below), the Project is not anticipated to have a significant impact on migratory corridors. Eelgrass is a factor which contributes to EFH productivity and has been mapped within the Study Area and is discussed in more detail below.

EELGRASS

Changes in shade can be deleterious to aquatic vegetative communities beneath and near the new structures. Eelgrass has been documented within the Study Area, primarily within areas adjacent to the shoreline and is a sensitive habitat under CEQA.

Eelgrass grows in waters shallower than 12 feet below (MLLW) in clear, protected bays and harbors. In San Francisco Bay, it is limited to significantly shallower areas due to the highly turbid conditions common to San Francisco Bay (NMFS 2014). Major elements of the proposed Project in Phase 1, such as the new pier, mooring piles, potential expanded trestle, and floating docks are located fully or partially within deep, subtidal areas approximately 20 feet below MLLW. These areas have no potential to support eelgrass beds. However, portions of these structures which overlap with areas along the shoreline may affect eelgrass by the expanded footprint of overwater structures as they are constructed with a solid deck to allow vehicles and equipment to be loaded and unload from these new structures. The expanded shade footprint therefore may impede current eelgrass extent and future expanse. As such, expansion of structures associated with Phase 1 may reduce eelgrass extent within the Study Area and would be considered a significant impact under CEQA. In addition, expanded dredging to account for navigational safety as part of Phase 1 would impact areas at suitable elevations for eelgrass.

Potential Impact BIO-12: Eelgrass

Project elements will be expanded along the intertidal zone and shallow portions of the subtidal zone. The expanded shade footprint in this area has the potential to exclude eelgrass beds or restrict their future expansion. Impacts by the Project to eelgrass beds would be considered a significant under CEQA.

To reduce potential impacts to eelgrass to a less-than-significant level, Mitigation measures BIO-1 through BIO-6 shall be implemented, and the following measure shall also be implemented.

> **Mitigation Measure BIO-13: Eelgrass**
>
> For the protection and mitigation of impacts to eelgrass, surveys and assessments as well as mitigation prescribed in the CEMP (NMFS 2014) (or its subsequent replacement document) will be implemented by the Project. As stated in the CEMP, the Project will be required to perform the following series of surveys and assessments associated with potential impacts to eelgrass. Should the final determination be that eelgrass beds were negatively affected by the project, mitigation options are also provided below as stated in the CEMP and will be implemented.

1. No more than 60 days before implementation of construction, an eelgrass survey will be conducted within the Study Area, as well as within a reference site to document baseline conditions for eelgrass presence. All eelgrass surveys shall occur during the growth period for eelgrass within San Francisco Bay (April – October).
2. Following construction, the Study Area and reference site will be resurveyed three times.
    a. The first survey will occur within 30 days following the completion of construction, or within the first 30 days of the next eelgrass growth period if construction completes outside of the eelgrass growing period.
    b. The second post-construction survey should be performed approximately one year after the first post-construction survey during the appropriate growing season.
    c. The third postconstruction survey should be performed approximately two years after the first postconstruction survey during the appropriate growing season.
3. Once surveys are completed, a report will be provided to NMFS to make a final determination regarding the actual impact and amount of mitigation needed, if any, to offset impacts. The determination will be made based upon the results of annual post-construction surveys, which document the changes in the eelgrass habitat (areal extent, bottom coverage, and shoot density within eelgrass) in the vicinity of the Study Area, compared to eelgrass habitat change at the reference site(s). Any impacts determined by these monitoring surveys will be mitigated with one of the following options:
    a. ***Draft and implement a comprehensive management plan (CMP).*** In general, it is anticipated that CMPs may be most appropriate in situations where a project or collection of similar projects will result in incremental but recurrent impacts to a small portion of local eelgrass populations through time (e.g., lagoon mouth maintenance dredging, maintenance dredging of channels and slips within established marinas, navigational hazard removal of recurrent shoals, shellfish farming, and restoration or enhancement actions).
    b. ***In-kind mitigation.*** In-kind compensatory mitigation is the creation, restoration, or enhancement of habitat to mitigate for adverse impacts to the same type of habitat. In most cases in-kind mitigation is the preferred option to compensate for impacts to eelgrass under the CEMP. Generally, in-kind mitigation should achieve a final mitigation ratio of 1.2:1 unless otherwise stated by NMFS during consultation.
    c. ***Mitigation banks and in-lieu-fee programs.*** Under the CEMP, NMFS supports the use of mitigation bank and in-lieu fee programs to compensate for impacts to eelgrass habitat, where such instruments are available and where such programs are appropriate to the statutory structure under which mitigation is recommended. Mitigation banks and in-lieu fee conservation programs are highly encouraged by NMFS in heavily urbanized waters. Credits should be used at a ratio of 1:1 if those credits have been established for a full three-year period prior to use. If the bank credits have been in place for a period less than three years, credits should be used at a ratio determined through application of the wetland mitigation calculator.

d. ***Out-of-kind mitigation.*** Out-of-kind compensatory mitigation means the adverse impacts to one habitat type are mitigated through the creation, restoration, or enhancement of another habitat type. In most cases, out-of-kind mitigation is discouraged, because eelgrass is a rare, special-status habitat in California. There may be some scenarios, however, where out-of-kind mitigation for eelgrass impacts is ecologically desirable or when in-kind mitigation is not feasible. This determination should be made based on an established ecosystem plan that considers ecosystem function and services relevant to the geographic area and specific habitat being impacted. Any proposal for out-of-kind mitigation should demonstrate that the proposed mitigation will compensate for the loss of eelgrass habitat function within the ecosystem. Out-of-kind mitigation that generates services similar to eelgrass habitat or improves conditions for establishment of eelgrass should be considered first.

4. The Project may also choose to propose mitigation with any of the above methods based on an analysis of impacts from only the 60-day preconstruction survey and the 30-day post construction survey.

With the implementation of Mitigation measure BIO-13, effects to eelgrass will be less than significant with mitigation incorporated.

All elements in Phase 2 and 3 would be anticipated to have similar effects to EFH including having the potential to affect eelgrass. Impacts to EFH for Phases 2 and 3 would ultimately be reduced to less than significant levels with mitigation incorporated through the implementation of Mitigation Measure BIO-13.

7.3 Aquatic Resources

This section analyzes the Project's potential impacts and mitigation for wetlands and other areas presumed or determined to be within the jurisdiction of the Corps or BCDC in reference to the significance threshold outlined in CEQA Appendix G, Part IV (c):

> *c) Does the Project have the potential to have a substantial adverse effect on state or federally protected wetlands as defined by Section 404 of the Clean Water Act (including, but not limited to, marsh, vernal pool, coastal, etc.) through direct removal, filling, hydrological interruption, or other means;*

7.3.1 Phase 1 Impacts and Mitigation

The nature of the Project means that it will need to affect open waters of San Francisco Bay. As described above, Phase 1 will increase the over water cover within the Project Area by a net increase of 28,180 sq. ft. These impacts to aquatic resources are accounted for in Impact BIO-6 (Shading) and mitigated to a level that is less than significant by Mitigation Measure BIO-9. In addition, in-water construction in Phase 1 will result in the following potentially significant impacts discussed above for special status species:

- **Potential Impact BIO-1:** Potential Introduction of Invasive Species
- **Potential Impact BIO-2:** Spills and Debris
- **Potential Impact BIO-3:** Dredging Related Turbidity and Toxic Materials
- **Potential Impact BIO-4:** Creosote Pile Removal

These impacts are mitigated to a level of less than significant by Mitigation Measures BIO-1 through BIO-7, all of which would apply to Phases 2 and 3. Implementation of Phase 1 would result in installation of approximately 305 new piles (and removal of 129 existing piles) within aquatic areas in Morro Cove. Installation of piles in aquatic areas does not have a substantial adverse effect on the continued water resources function of a water body, as demonstrated by the fact that the U.S. Army Corps of Engineers does not regulate piles as fill under the Clean Water Act (see *33CFR328.3*). Therefore, the installation of piles themselves is a less than significant impact. Potential impacts to aquatic resources from the installation of piles are associated with the over-water structures that they support. Potential impacts related to over-water structures are covered by Impact BIO-6 and mitigated by implementation of Mitigation Measures BIO-BIO-9.

7.3.2 Phase 2 and 3 Impacts and Mitigation

Implementation of Phases 2 and 3 of the Project will continue to develop future waterfront and over-water facilities or replace existing facilities. It is anticipated that effects from Phases 2 and 3 will more than double the area of over water cover present after completion of Phase 1 as these Phases will create new infrastructure associated with an expanded boat basin. As such, Phases 2 and 3 are anticipated to have larger scale effects to aquatic resources as compared to Phase 1. These impacts are described in Impact BIO-6 (Shading) and mitigated to a level that is less than significant by Mitigation Measure BIO-9, both of which would apply to Phases 2 and 3. Similar to Phase 1, Phases 2 and 3 would have the potential to result in construction related impacts to aquatic resources from over-water and shoreline construction. These impacts are covered by Impact BIO-1 through BIO-4 and are mitigated to a level of less than significant by Mitigation Measures BIO-1 through BIO-7. All of these impacts and mitigation measures would apply to Phases 2 and 3 as well as Phase 1.

Phase 3 is anticipated to include creation of a living reef along the northwestern shoreline. Addition of a living reef will benefit to aquatic resources productivity through the creation of complex and preferred fisheries habitats. As such, though this element would provide a net ecological uplift to aquatic resources in the Project Area which will be considered as partial mitigation for impacts associated with Phase 3. Creation of the living shoreline would result in temporary construction impacts discussed above for other elements of the Project, but would result in a long term benefit to aquatic resources.

7.4 Wildlife Corridors and Native Wildlife Nursery Sites

This section analyzes the Project's potential impacts and mitigation for habitat corridors and linkages in reference to the significance threshold outlined in CEQA Appendix G, Part IV (d):

> *d) Does the Project have the potential to interfere substantially with the movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites;*

As noted above in Section 5.2.2, special-status fish are known to migrate through the waters of the Study Area when making seasonal movements between core habitat areas (e.g. natal streams or the Pacific Ocean). Maintaining the ability of these species to migrate between core habitat areas is necessary for the continuation of these species and maintenance of the wildlife corridor which connects them.

7.4.1 Phase 1 Impacts and Mitigation

The Study Area's aquatic communities do not support rookery sites, or colonial nesting sites for species such as egrets, herons, or marine mammals therefore no such nursery sites will be affected. The Study Area does contain small portions of eelgrass (Figure 5, Appendix A) which can function as a nursery site for fish species such as Pacific herring which can spawn and rear within eelgrass. The Study Area also lies along the migratory route for salmonids when moving from natal streams in the Central Valley, and the Pacific Ocean, as such it also functions as a migratory corridor for fish. If construction were to occur at times of year when larval fish were present, or when migratory events for fish were occurring, construction activities may have the potential to impact such events, which would be considered a significant impact under CEQA.

However, Mitigation Measure BIO-2 will restrict any in water work to July 1-November 30, which is outside of when salmonids or other anadromous species typically migrate to the ocean, or when they return to natal streams. Thus, implementation of Mitigation measure BIO-2 reduces impacts to migratory corridors to less than significant levels. Further, by timing in-water construction activities later in the summer and fall, this is outside of the time when larval or fry life-stages of fish are present. Therefore while Pacific herring or other native species might rear within the limited eelgrass beds, any construction would occur outside of the times when sensitive life stages are present. Implementing additional Mitigation Measures BIO-1 through BIO-9 (excluding Mitigation Measure BIO-9 for nesting Birds) also reduces the potential impacts to fish during critical periods by maintaining habitat quality such that when fish do return, there is not toxic conditions that might deleteriously affect them.

The future buildout of Phases 1 will upgrade or expand upon elements which extend outward into the Bay, however the current pier and wharf to support the TSGB extends approximately 200 feet outward from shore to its furthest point. The new pier will be slightly larger, extending roughly 225 feet outward from shore, resulting in approximately a 25-foot increase in length. At this location, the Carquinez Strait is approximately 3,300 feet wide. Therefore, the extension of the pier would increase shade across approximately 0.001 percent of the width of the Carquinez Strait.

Additionally, new elements of Phase 1 do not create an aquatic net, trap or barrier that might impede fish movement. The linear pier and breakwater within are permeable to water and fish movement in multiple locations such that a fish may move around these objects easily, without risk of being trapped behind an impermeable barrier. As such the new structures do not represent a significant barrier that would cause a cessation to movement, disorientation, or significant delay for migrating fish. Any immediate effects to migration or natal sites from construction are largely avoided through the use of the in-water work window, while all remaining mitigation measures reduce potential indirect effects that might alter habitat suitability later in time. As such implementation of Mitigation Measures BIO-1 through BIO-9 will reduce any effects to nursery sites or migratory corridors to less than significant levels.

7.4.2 Phases 2 and 3 Impacts and Mitigation

Similarly, to Phase 1, implementation of minimization measures described above will reduce potential construction related impacts to migratory corridors and critical habitat to less than significant levels. Mitigation for shading to open waters will also require mitigation through either habitat restoration or the purchase of mitigation credits which will also offset any potential effects to migratory habitats. However, as final elements of Phases 2 and 3 are designed they may create a relatively enclosed and protected marina that may not be easily escaped by migrating fish should they stray into the future marina. If future elements created an impermeable marina, this may obstruct fish moving between habitats and as such could delay migration which would be a significant impact to migratory corridors under CEQA.

Potential Impact BIO-13 – Migratory Corridors

Future elements of Phases 2 and 3 may incorporate elements that pose higher risk to disruption of fish migration as marinas, breakwaters or similar features could fully enclose the future waterfront making it less likely that fish could volitionally exit the harbor during migration. This hinderance to migration could result in additional exposure to predation or anthropogenic disturbance which would be considered a significant impact under CEQA.

> **Mitigation Measure BIO-14 – Migratory Corridors**
>
> Future elements of Phases 2 and 3 should be designed to be permeable in such a way that the final design of the Waterfront Master Plan does not form a fully enclosed area which might trap or impede fish movement. Future elements should be designed to provide multiple exit routes at all tides such that fish moving through the vicinity can enter or exit the waterfront facilities at will, through multiple locations thereby minimizing the potential to be affected by marina operations.

In addition to implementation of the various mitigation measures described above, implementation of Mitigation Measure BIO-13 effects to migratory corridors will be less than significant with mitigation incorporated.

7.5 Local Policies and Ordinances

This section analyzes the Project's potential impacts and mitigation based on conflicts with local policies and ordinances in reference to the significance threshold outlined in CEQA Appendix G, Part IV (e):

> *e) Does the Project have the potential to conflict with any local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance;*

The proposed Project is located in the City of Vallejo but is State-owned property managed by the University. City of Vallejo General Plan Policies NBE-1.1, NBE-1.2, NBE-1.3, NBE-1.4, and NBE-1.6 are directly and indirectly related to biological resources in the Project Area. Because the Project is a University sponsored project occurring on University owned property, adherence to the requirements of the City of Vallejo General Plan, as well as other local policies and ordinances related to biological resources, is not strictly required. However, the Project is consistent with these local policies and ordinances both through design (e.g., enhancement of open space and aquatic resources associated with Phases 2 and 3) and through mitigation measures to protect environmental resources described above and required as part of the Project.

Elements of Phase 2 and 3 are anticipated to be similarly reviewed through the CEQA process, and with continued implementation of Mitigation measure BIO-11 would be anticipated to be in agreement with local policies and ordinances.

7.6 Habitat Conservation Plans

This section analyzes the Project's potential impacts and mitigation based on conflicts with any adopted local, regional, and state habitat conservation plans in reference to the significance threshold outlined in CEQA Appendix G, Part IV (f):

> *f) Does the Project have the potential to conflict with the provisions of an adopted Habitat Conservation Plan, Natural Community Conservation Plan, or other approved local, regional, or state habitat conservation plan.*

Currently the only Habitat Conservation Plan (HCP) which overlaps with the Study Area is the Solano County HCP; however, this HCP was never completed or approved. This HCP is overseen by the Solano County Water Agency (LSA 2012). The Study Area for this proposed Project is already developed and occurs within the Urban Development Footprint projected for the Solano HCP. Morrow Cove is also not one of the proposed aquatic areas or drainages ranked as a priority for conservation. Lastly, the majority of the Solano HCP focuses on uplands and streams, less so than open waters of the Bay. Therefore, the Waterfront Master Plan and all of its Phases occur in an area that is projected as part of the urban expansion boundary and does not conflict with the provisions of the Solano HCP as it largely covers uplands and streams which are not marked for conservation within the Study Area.

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APPENDIX A. FIGURES

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Sources: National Geographic, WRA | Prepared By: rochelle, 11/21/2023

Figure 1. Study Area Location

Cal Maritime Waterfront Masterplan
Vallejo, California

0 0.25 0.5 Miles

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Sources: USDA NAIP Imagery 2020, WRA | Prepared By: rochelle, 11/21/2023

Figure 2. Study Area Aerial Map

Cal Maritime Waterfront Master Plan
Vallejo, California

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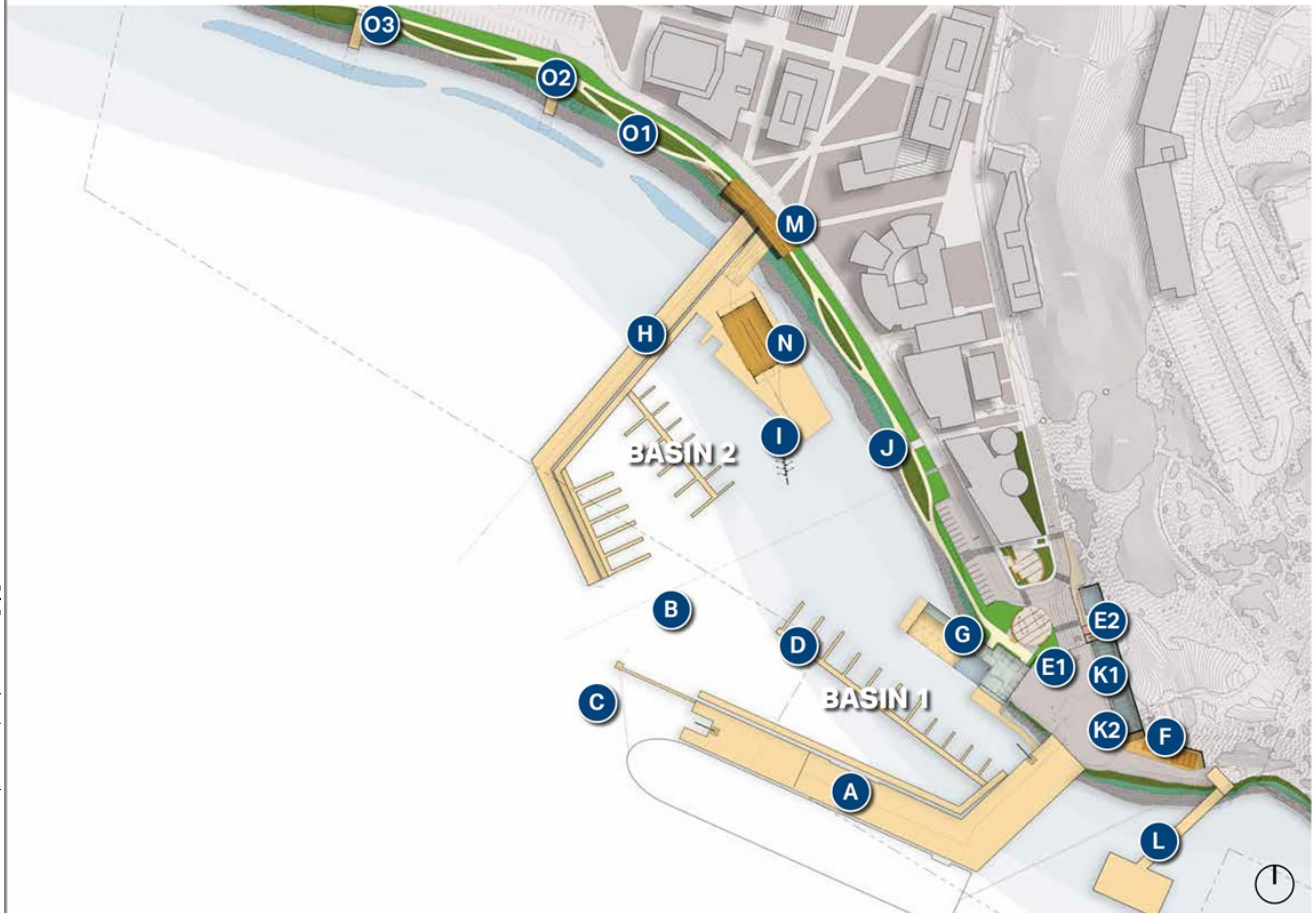

Legend

A	Main Pier Expansion
B	Dredging of Boat Basin and Approaches (As Necessary)
C	Navigation Aids
D	New Floating and Training Docks at Basin 1
E1	Marine Logistical Yard Upgrade (Linking Gatehouse to Pierhead)
E2	Yard Expansion and New Site Retaining Wall
F	Utilities Relocation and Upgrade
G	Seismic Retrofit and Renovation of Boathouse
H	New Accessible Breakwater and Creation of Basin 2
I	New Floating and Training Docks at Basin 2
J	Shoreline Enhancements (Boathouse to New Accessible Breakwater)
K1	Marine Programs Multi-Use Building
K2	Harbor Control Tower
L	Marine Hydrokinetic (MHK) Barge and Linking Trestle
M	Central Waterfront Esplanade Canopy
N	Row House and Floating Landing
O1	Shoreline Enhancements (Row House to Dining Center)
O2	Waterfront Overlook / Outdoor Room One
O3	Waterfront Overlook / Outdoor Room Two

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WRA | Prepared By: njander, 10/2/2023

Figure 3. Master Waterfront Plan Buildout for Phases 1, 2 and 3

Cal Maritime Waterfront Master Plan
Vallejo, California

0 100 200 Feet

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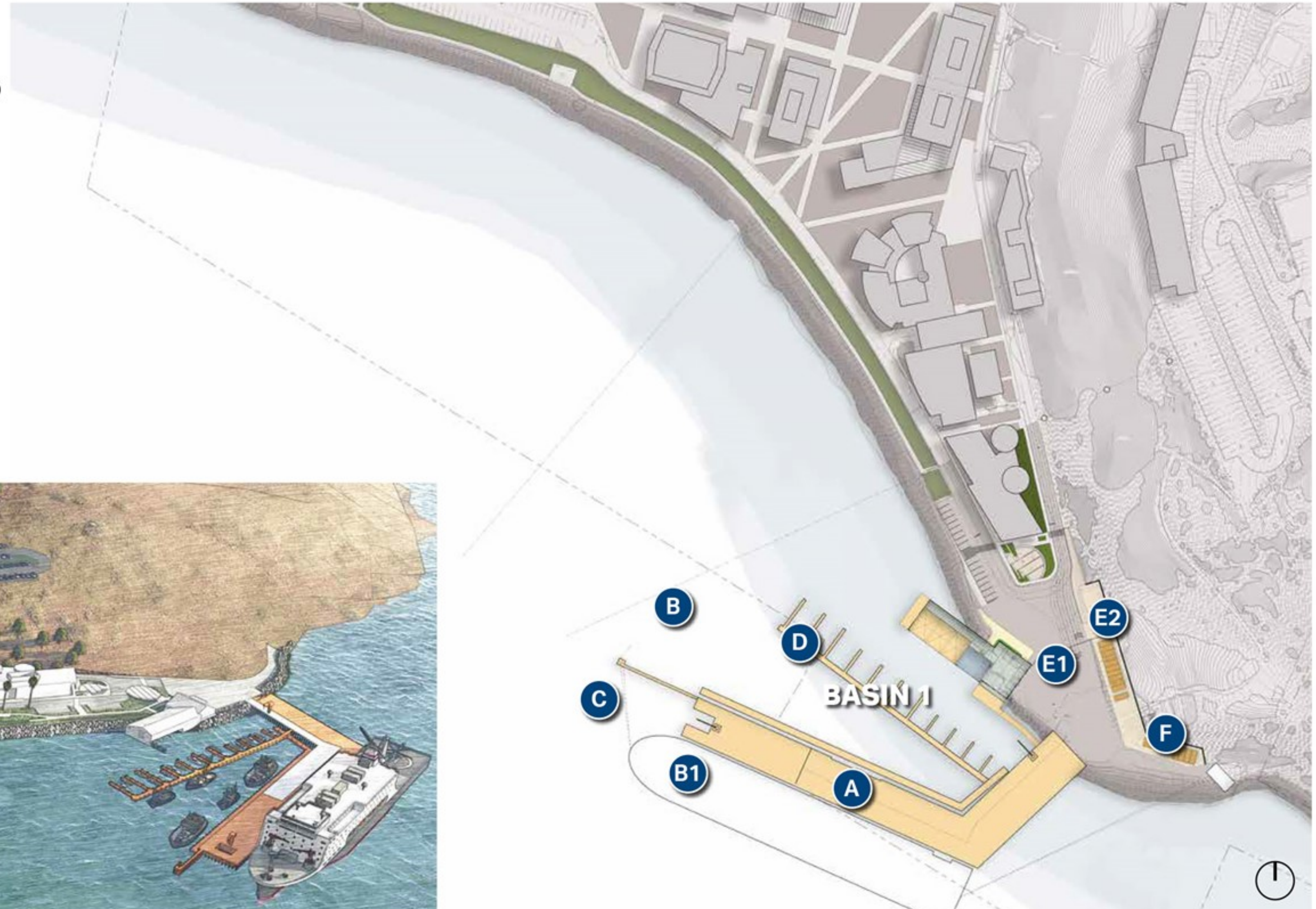
wra Environmental Consultants

Legend

A	Main Pier Expansion
B	Dredging of Boat Basin and Approaches (As Necessary)
C	Navigation Aids
D	New Floating and Training Docks at Basin 1
E1	Marine Logistical Yard Upgrade (Linking Gatehouse to Pierhead)
E2	Yard Expansion and New Site Retaining Wall
F	Utilities Relocation and Upgrade



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Phase One Components

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WRA | Prepared By: njander, 10/2/2023

Figure 4. Phase 1 Concept Plan

Cal Maritime Waterfront Master Plan
Vallejo, California

0 100 200 Feet

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wra Environmental Consultants

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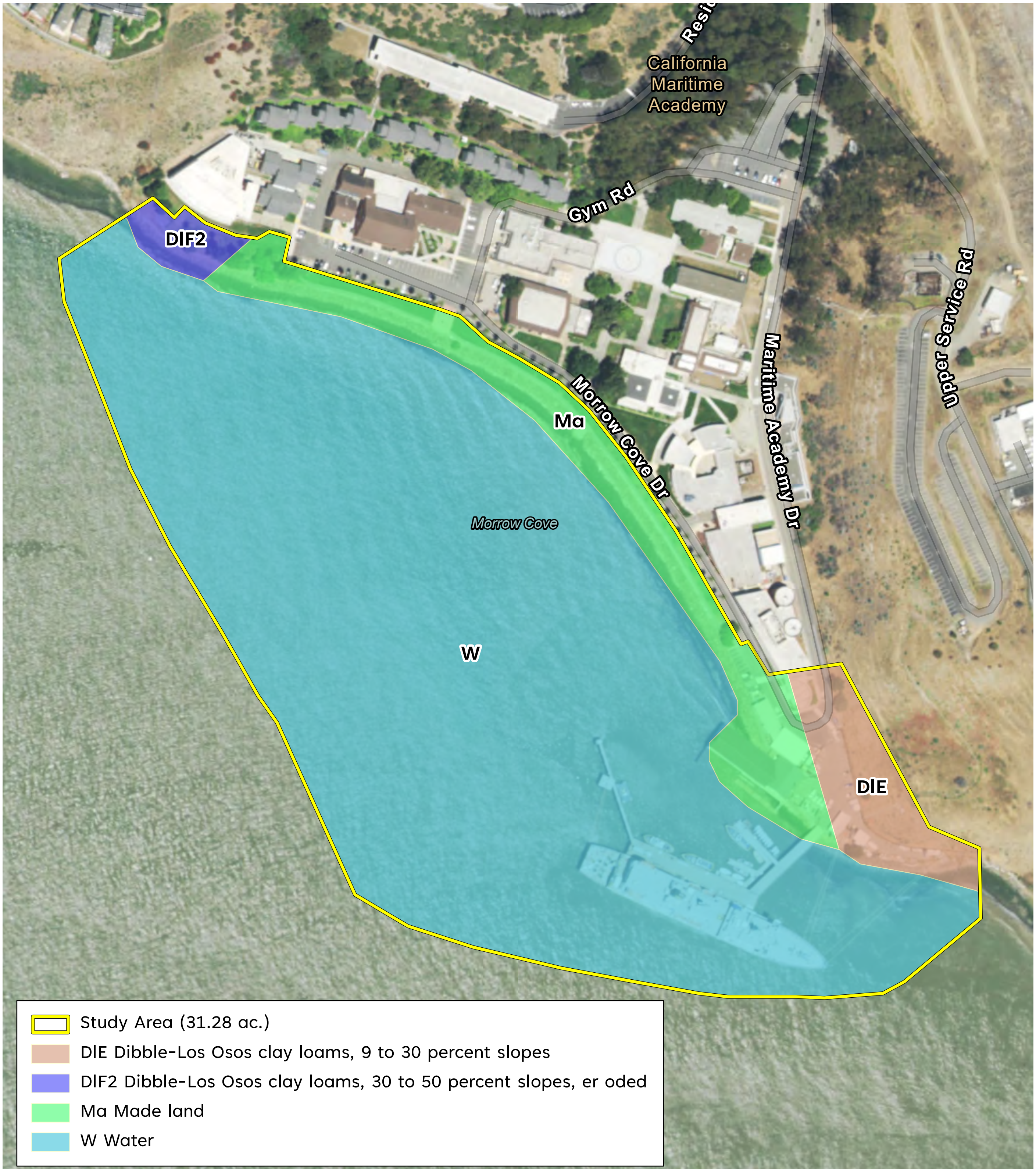
Sources Solano County Imagery 2021, WRA | Prepared By: rochelle, 11/28/2023

Figure 5. Land Cover, Jurisdictional Boundaries, and Overwater Structures Map

Cal Maritime Waterfront Master Plan
Vallejo, California

wra Environmental Consultants



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Sources USDA NAIP Imagery 2020, USDA SURRGO, WRA | Prepared By: rochelle, 11/21/2023

Figure 6. Soils Map

Cal Maritime Waterfront Master Plan
Vallejo, California

wra Environmental Consultants

Path: L:\Acad 2000 Files\31000\31415\GIS\ArcMap\31415Base.aprx Layout Name: BRTR_Fig7_Critical Habitat

Sources Solano County Imagery 2021, WRA | Prepared By: rochelle, 11/21/2023

Figure 7. Critical Habitat

wra Environmental Consultants

Cal Maritime Waterfront Master Plan
Vallejo, California

APPENDIX B. SPECIAL-STATUS SPECIES POTENTIAL TABLE

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Appendix B. Potential for Special Status Plant and Wildlife Species to Occur within the Study Area. List Compiled from the California Department of Fish and Wildlife Natural Diversity Database (CDFW 2023), U.S. Fish and Wildlife Service Information for Planning and Consultation Species Lists (USFWS 2023), and California Native Plant Society Rare Plant Inventory (CNPS 2023) search of the Benicia and surrounding eight U.S. Geological Survey 7.5' quadrangles (Cordelia, Briones Valley, Walnut Creek, Richmond, Vine Hill, Fairfield South, Mare Island, and Cuttings Wharf).

SCIENTIFIC NAME	STATUS[1]	HABITAT	POTENTIAL FOR OCCURRENCE	RECOMMENDATIONS
PLANTS				
Lyngbye's sedge *Carex lyngbyei*	Rank 2B.2	Marshes and swamps (brackish, freshwater). Elevation ranges from 0 to 35 feet (0 to 10 meters). Blooms Apr-Aug.	**Unlikely.** The Study Area does not contain marsh/swamp (brackish, freshwater) habitats to support this species. In addition, the bay shoreline within the Study Area is developed and consist of artificial (riprap) substrate with limited to no sediment deposition to form mud banks.	No recommendations for this species.
Bolander's water-hemlock *Cicuta maculata* var. *bolanderi*	Rank 2B.1	Marshes and swamps (brackish, coastal, freshwater). Elevation ranges from 0 to 655 feet (0 to 200 meters). Blooms Jul-Sep.	**Unlikely.** The Study Area does not contain marsh/swamp (brackish, coastal, freshwater) habitat to support this species. In addition, the bay shoreline within the Study Area is developed and consist of artificial (riprap) substrate with limited to no sediment deposition to form mud banks.	No recommendations for this species.
Suisun thistle *Cirsium hydrophilum* var. *hydrophilum*	FE, Rank 1B.1	Marshes and swamps (salt). Elevation ranges from 0 to 5 feet (0 to 1 meters). Blooms Jun-Sep.	**Unlikely.** The Study Area does not contain marsh/swamp (salt) habitat to support this species. In addition, the bay shoreline within the Study Area is developed and consist of artificial (riprap) substrate with limited to no sediment deposition to form mud banks.	No recommendations for this species.

SCIENTIFIC NAME	STATUS[1]	HABITAT	POTENTIAL FOR OCCURRENCE	RECOMMENDATIONS
small spikerush *Eleocharis parvula*	Rank 4.3	Marshes and swamps. Elevation ranges from 5 to 9910 feet (1 to 3020 meters). Blooms (Apr)Jun-Aug(Sep).	**Unlikely.** The Study Area does not contain marsh/swamp habitat to support this species. In addition, the bay shoreline within the Study Area is developed and consist of artificial (riprap) substrate with limited to no sediment deposition to form mud banks.	No recommendations for this species.
Delta tule pea *Lathyrus jepsonii* var. *jepsonii*	Rank 1B.2	Marshes and swamps (brackish, freshwater). Elevation ranges from 0 to 15 feet (0 to 5 meters). Blooms May-Jul(Aug-Sep).	**Unlikely.** The Study Area does not contain marsh/swamp (brackish, freshwater) habitat to support this species. In addition, the bay shoreline within the Study Area is developed and consist of artificial (riprap) substrate with limited to no sediment deposition to form mud banks.	No recommendations for this species.
Mason's lilaeopsis *Lilaeopsis masonii*	SR, Rank 1B.1	Marshes and swamps (brackish, freshwater), riparian scrub. Elevation ranges from 0 to 35 feet (0 to 10 meters). Blooms Apr-Nov.	**Unlikely.** The Study Area does not contain marsh/swamp and riparian scrub habitat to support this species. In addition, the bay shoreline within the Study Area is developed and consist of artificial (riprap) substrate with limited to no sediment deposition to form mud banks.	No recommendations for this species.
Delta mudwort *Limosella australis*	Rank 2B.1	Marshes and swamps (brackish, freshwater), riparian scrub. Elevation ranges from 0 to 10 feet (0 to 3 meters). Blooms May-Aug.	**Unlikely.** The Study Area does not contain marsh/swamp and riparian scrub habitat to support this species. In addition, the bay shoreline within the Study Area is developed and consist of artificial (riprap) substrate with limited to no sediment deposition to form mud banks.	No recommendations for this species.

SCIENTIFIC NAME	STATUS[1]	HABITAT	POTENTIAL FOR OCCURRENCE	RECOMMENDATIONS
Marin knotweed *Polygonum marinense*	Rank 3.1	Marshes and swamps (brackish, coastal salt). Elevation ranges from 0 to 35 feet (0 to 10 meters). Blooms (Apr)May-Aug(Oct).	**Unlikely.** The Study Area does not contain marsh/swamp (brackish, coastal salt) habitat to support this species. In addition, the bay shoreline within the Study Area is developed and consist of artificial (riprap) substrate with limited to no sediment deposition to form mud banks.	No recommendations for this species.
northern slender pondweed *Stuckenia filiformis* ssp. *alpina*	Rank 2B.2	Marshes and swamps (shallow freshwater). Elevation ranges from 985 to 7055 feet (300 to 2150 meters). Blooms May-Jul.	**No Potential.** The Study Area does not contain marsh/swamp (shallow freshwater) habitat to support this species.	No recommendations for this species.
California seablite *Suaeda californica*	FE, Rank 1B.1	Marshes and swamps (coastal salt). Elevation ranges from 0 to 50 feet (0 to 15 meters). Blooms Jul-Oct.	**Unlikely.** The Study Area does not contain marsh/swamp (coastal salt) habitat to support this species. In addition, the bay shoreline within the Study Area is developed and consist of artificial (riprap) substrate with limited to no sediment deposition to form mud banks.	No recommendations for this species.
Suisun Marsh aster *Symphyotrichum lentum*	Rank 1B.2	Marshes and swamps (brackish, freshwater). Elevation ranges from 0 to 10 feet (0 to 3 meters). Blooms (Apr)May-Nov.	**Unlikely.** The Study Area does not contain marsh/swamp (brackish or freshwater) habitat to support this species. In addition, the bay shoreline within the Study Area is developed and consist of artificial (riprap) substrate with limited to no sediment deposition to form mud banks.	No recommendations for this species.
WILDLIFE				
MAMMALS				

SCIENTIFIC NAME	STATUS[1]	HABITAT	POTENTIAL FOR OCCURRENCE	RECOMMENDATIONS
salt-marsh harvest mouse *Reithrodontomys raviventris*	FE, SE, CFP	Endemic to emergent salt and brackish wetlands of the San Francisco Bay Estuary. Pickleweed marshes are primary habitat; also occurs in various other wetland communities with dense vegetation. Does not burrow, builds loosely organized nests. Requires higher areas for flood escape.	**No Potential.** The Study Area does not contain saltmarsh which is required to support this species.	No further action is necessary for this species.
salt-marsh wandering shrew *Sorex vagrans halicoetes*	SSC	Salt marshes of the south arm of San Francisco Bay. Medium high marsh 6 to 8 feet above sea level where abundant driftwood is scattered among *Salicornia*.	**No Potential.** The Study Area is on the north side of San Pablo Bay which is outside of the range, for this species.	No further action is necessary for this species.
MARINE MAMMALS				
California sea lion *Zalophus californianus*	MMPA	Range from central Mexico to British Columbia, Canada. Feeds on various fish and squid. Primary breeding range is from the Channel Islands in California to Southern Mexico.	**Present.** This species is known to occur in the vicinity of the Carquinez Strait.	See section 5.2.2 for further discussion concerning this species.
harbor porpoise *Phocoena phocoena*	MMPA	Inhabits temperate and subarctic waters in California from Morro Bay north. Found in bays, estuaries, harbors, and fjords. Occurs in San Francisco Bay, primarily north of the Golden Gate Bridge.	**Unlikely.** This species is known to occur in the vicinity of the Golden Gate Bridge but largely restricts its distribution to fully marine salinities closer to the Pacific Ocean.	No further action is necessary for this species.

SCIENTIFIC NAME	STATUS[1]	HABITAT	POTENTIAL FOR OCCURRENCE	RECOMMENDATIONS
harbor seal *Phoca vitulina*	MMPA	Broadly distributed in coastal areas of the northern hemisphere. Most significant haul-out site in south San Francisco Bay is at Mowry Slough. Pups are born in March and April in Northern California.	**Present.** This species is known to occur in the vicinity of the Carquinez Strait.	See section 5.2.2 for further discussion concerning this species.
BIRDS				
bald eagle *Haliaeetus leucocephalus*	FD, SE, CFP, BCC	Occurs year-round in California, but primarily a winter visitor; breeding population is growing. Nests in large trees in the vicinity of larger lakes, reservoirs and rivers. Wintering habitat somewhat more variable but usually features large concentrations of waterfowl or fish.	**Unlikely (nesting); Moderate Potential (foraging).** The Study Area is composed of fully developed or otherwise disturbed uplands. Large trees/snags typical of nesting are not present. The species may be observed in the vicinity foraging within the waters/shorelines of San Pablo Bay including occasionally within the Study Area.	Any potential impacts to foraging habitat and resources will be negligible given the large areas of foraging habitat around the estuary. No significant impacts will result and further action is necessary for this species.

SCIENTIFIC NAME	STATUS[1]	HABITAT	POTENTIAL FOR OCCURRENCE	RECOMMENDATIONS
bank swallow *Riparia riparia*	ST	Summer resident in riparian and other lowland habitats near rivers, lakes and the ocean in northern California. Nests colonially in excavated burrows on vertical cliffs and bank cuts (natural and manmade) with fine-textured soils. Historical nesting range in southern and central areas of California has been eliminated by habitat loss. Currently known to breed in Siskiyou, Shasta, and Lassen Cos., portions of the north coast, and along Sacramento River from Shasta Co. south to Yolo Co.	**No Potential.** This species is only known to occur on large vertical rock faces and cliffs which are not present within the Study Area.	No further action is necessary for this species.
black-crowned night heron *Nycticorax nycticorax*	none (breeding sites protected by CDFW)	Year-round resident. Nests colonially, usually in trees but also in patches of emergent vegetation. Rookery sites are often on islands and usually located adjacent to foraging areas: margins of lakes and bays.	**Unlikely.** Colonial roosting by this species is not known to occur within the Study Area. Large trees are absent which might support a roost of this species.	No further action is necessary for this species.
California black rail *Laterallus jamaicensis coturniculus*	ST, CFP	Year-round resident in marshes (saline to freshwater) with dense vegetation within four inches of the ground. Prefers larger, undisturbed marshes that have an extensive upper zone and are close to a major water source. Extremely secretive and cryptic.	**No Potential.** This species is only known to occur in marsh habitats. Shorelines are composed entirely of rip-rap and developed surfaces. No suitable marsh habitat is present to support this species within or adjacent to the Study Area.	No further action is necessary for this species.

SCIENTIFIC NAME	STATUS[1]	HABITAT	POTENTIAL FOR OCCURRENCE	RECOMMENDATIONS
California brown pelican *Pelecanus occidentalis californicus*	FD, SD, CFP	(Nesting colony) colonial nester on coastal islands just outside the surf line. Nests on coastal islands of small to moderate size which afford immunity from attack by ground-dwelling predators.	**No Potential.** While this species is known to forage within the waters of San Pablo Bay, there are no offshore islands or similar habitats to support nesting by this species.	No further action is necessary for this species.
California least tern *Sternula antillarum browni*	FE, SE, CFP	Summer resident along the coast from San Francisco Bay south to northern Baja California; inland breeding also very rarely occurs. Nests colonially on barren or sparsely vegetated areas with sandy or gravelly substrates near water, including beaches, islands, and gravel bars. In San Francisco Bay, has also nested on salt pond margins.	**No Potential.** This species only nests within sandy beaches or similar flat gravel areas. Shorelines are composed entirely of rip-rap and developed surfaces extend inland. No suitable sandy or gravel habitat is present to support nesting for this species.	No further action is necessary for this species.
California Ridgway's (clapper) rail *Rallus obsoletus obsoletus*	FE, SE, CFP	Year-round resident in tidal marshes of the San Francisco Bay estuary. Requires tidal sloughs and intertidal mud flats for foraging, and dense marsh vegetation for nesting and cover. Typical habitat features abundant growth of cordgrass and pickleweed. Feeds primarily on molluscs and crustaceans.	**No Potential.** This species is only known to occur in marsh habitats. Shorelines are composed entirely of rip-rap and developed surfaces. No suitable marsh habitat is present to support this species within or adjacent to the Study Area.	No further action is necessary for this species.

SCIENTIFIC NAME	STATUS[1]	HABITAT	POTENTIAL FOR OCCURRENCE	RECOMMENDATIONS
double-crested cormorant *Phalacrocorax auritus*	DFG:WL	(Rookery site) colonial nester on coastal cliffs, offshore islands, and along lake margins in the interior of the state. Nests along coast on sequestered islets, usually on ground with sloping surface, or in tall trees along lake margins.	**Unlikely.** Colonial roosting by this species is not known to occur within the Study Area. Large trees are limited to fully developed areas further minimizing the likelihood that the Study Area could support a roost.	No further action is necessary for this species.
great blue heron *Ardea herodias*	none (breeding sites protected by CDFW); CDF sensitive	Year-round resident. Nests colonially or semi-colonially in tall trees and on cliffs, also sequestered terrestrial substrates. Breeding sites usually in close proximity to foraging areas: marshes, lake margins, tidal flats, and rivers. Forages primarily on fishes and other aquatic prey, also smaller terrestrial vertebrates.	**Unlikely.** Colonial roosting by this species is not known to occur within the Study Area. Large trees are limited to fully developed areas further minimizing the likelihood that the Study Area could support a roost.	No further action is necessary for this species.
great egret *Ardea alba*	none (breeding sites protected by CDFW); CDF sensitive	Year-round resident. Nests colonially or semi-colonially, usually in trees, occasionally on the ground or elevated platforms. Breeding sites usually in close proximity to foraging areas: marshes, lake margins, tidal flats, and rivers. Forages primarily on fishes and other aquatic prey, also smaller terrestrial vertebrates.	**Unlikely.** Colonial roosting by this species is not known to occur within the Study Area. Large trees are limited to fully developed areas further minimizing the likelihood that the Study Area could support a roost.	No further action is necessary for this species.

SCIENTIFIC NAME	STATUS[1]	HABITAT	POTENTIAL FOR OCCURRENCE	RECOMMENDATIONS
San Francisco (saltmarsh) common yellowthroat *Geothlypis trichas sinuosa*	BCC, SSC	Resident of the San Francisco Bay region, in fresh and salt water marshes. Requires thick, continuous cover down to water surface for foraging; tall grasses, tule patches, willows for nesting.	**No Potential.** This species is only known to occur in marsh habitats or densely vegetated riparian areas adjacent to water. Shorelines are composed entirely of rip-rap and developed surfaces. No suitable marsh habitat is present to support this species.	No further action is necessary for this species.
short-eared owl *Asio flammeus*	SSC	Occurs year-round, but primarily as a winter visitor; breeding very restricted in most of California. Found in open, treeless areas (e.g., marshes, grasslands) with elevated sites for foraging perches and dense herbaceous vegetation for roosting and nesting. Preys mostly on small mammals, particularly voles.	**No Potential.** The Study Area does not contain open marsh or grasslands to support nesting by this species.	No further action is necessary for this species.
snowy egret *Egretta thula*	none (breeding sites protected by CDFW)	Year-round resident. Nests colonially, usually in trees, at times in sequestered beds of dense tules. Rookery sites usually situated close to foraging areas: marshes, tidal-flats, streams, wet meadows, and borders of lakes.	**Unlikely.** Colonial roosting by this species is not known to occur within the Study Area. Large trees are absent which might support a roost of this species.	No further action is necessary for this species.
Suisun song sparrow *Melospiza melodia maxillaris*	BCC, SSC	Year-round resident of brackish-water marshes along Suisun Bay. Inhabits cattails, tules, bulrushes and other emergent vegetation, including pickleweed. Nests typically placed in shrubs.	**No Potential.** This species is only known to occur in marsh habitats. Shorelines are composed entirely of rip-rap and developed surfaces. No suitable marsh habitat is present within or adjacent to the Study Area to support this species.	No further action is necessary for this species.

SCIENTIFIC NAME	STATUS[1]	HABITAT	POTENTIAL FOR OCCURRENCE	RECOMMENDATIONS
western snowy plover *Charadrius nivosus (alexandrines) nivosus*	FT, SSC, BCC, RP	Federal listing applies only to the Pacific coastal population. Year-round resident and winter visitor. Occurs on sandy beaches, salt pond levees, and the shores of large alkali lakes. Nests on the ground, requiring sandy, gravelly or friable soils.	**No Potential.** This species only nests within sandy beaches or alkaline flats. Shorelines are composed entirely of rip-rap and developed surfaces extend inland. No suitable habitat is present to support nesting for this species and shorelines are so steep they are unlikely to support foraging by this species.	No further action is necessary for this species.
yellow rail *Coturnicops noveboracensis*	BCC, SSC	Summer resident in eastern Sierra Nevada in Mono County, breeding in shallow freshwater marshes and wet meadows with dense vegetation. Also a rare winter visitor along the coast and other portions of the state. Extremely cryptic.	**No Potential.** This species is only known to occur in marsh habitats. Shorelines are composed entirely of rip-rap and developed surfaces. No suitable marsh habitat is present to support this species.	No further action is necessary for this species.
yellow-headed blackbird *Xanthocephalus xanthocephalus*	SSC	Summer resident. Breeds colonially in freshwater emergent wetlands with dense vegetation and deep water, often along borders of lakes or ponds. Requires abundant large insects such as dragonflies; nesting is timed for maximum emergence of insect prey.	**No Potential.** This species is only known to occur in marsh habitats. Shorelines are composed entirely of rip-rap and developed surfaces. No suitable marsh habitat is present to support this species.	No further action is necessary for this species.
REPTILES & AMPHIBIANS				

SCIENTIFIC NAME	STATUS[1]	HABITAT	POTENTIAL FOR OCCURRENCE	RECOMMENDATIONS
California red-legged frog *Rana draytonii*	FT, SSC, RP	Lowlands and foothills in or near permanent sources of deep water with dense, shrubby or emergent riparian vegetation. Requires 11 to 20 weeks of permanent water for larval development. Associated with quiet perennial to intermittent ponds, stream pools and wetlands. Prefers shorelines with extensive vegetation. Disperses through upland habitats after rains.	**No Potential.** The Study Area does not contain freshwater features to support any life stage of this species. Surrounding uplands are also developed with the UC campus, and preclude access by this species even if it were to occur in the vicinity.	No further action is necessary for this species.
California tiger salamander *Ambystoma californiense*	FE/FT, ST, RP	Populations in Santa Barbara and Sonoma counties currently listed as endangered; threatened in remainder of range. Inhabits grassland, oak woodland, ruderal and seasonal pool habitats. Adults are fossorial and utilize mammal burrows and other subterranean refugia. Breeding occurs primarily in vernal pools and other seasonal water features.	**No Potential.** The Study Area does not contain vernal pools or grasslands with burrowing mammals that could support this species. The surrounding uplands are developed with campus buildings and prevent any access by this species.	No further action is necessary for this species.

SCIENTIFIC NAME	STATUS[1]	HABITAT	POTENTIAL FOR OCCURRENCE	RECOMMENDATIONS
foothill yellow-legged frog (Central Coast DPS) pop 4 *Rana boylii*	FPT, ST	Found in or adjacent to rocky streams in a variety of habitats. Prefers partly-shaded, shallow streams and riffles with a rocky substrate; requires at least some cobble-sized substrate for egg-laying. Needs at least 15 weeks to attain metamorphosis. Feeds on both aquatic and terrestrial invertebrates.	**No Potential.** The Study Area does not contain freshwater streams to support this species.	No further action is necessary for this species.
foothill yellow-legged frog (north Coast DPS) pop 1 *Rana boylii*	SC, SSC	Found in or adjacent to rocky streams in a variety of habitats. Prefers partly-shaded, shallow streams and riffles with a rocky substrate; requires at least some cobble-sized substrate for egg-laying. Needs at least 15 weeks to attain metamorphosis. Feeds on both aquatic and terrestrial invertebrates.	**No Potential.** The Study Area does not contain freshwater streams to support this species.	No further action is necessary for this species.
Northern legless lizard *Anniella pulchra*	SSC	Fossorial species, inhabiting sandy or loose loamy soils under relatively sparse vegetation. Suitable habitat includes dunes, stream terraces, and scrub and chaparral. Adequate soil moisture is essential.	**No Potential.** The Study Area is outside of the known range for this species. In addition the Study Area does not contain sandy, loamy soils suitable for this species.	No further action is necessary for this species.

SCIENTIFIC NAME	STATUS[1]	HABITAT	POTENTIAL FOR OCCURRENCE	RECOMMENDATIONS
western pond turtle *Emys marmorata*	SSC	A thoroughly aquatic turtle of ponds, marshes, rivers, streams and irrigation ditches with aquatic vegetation. Require basking sites such as partially submerged logs, vegetation mats, or open mud banks, and suitable upland habitat (sandy banks or grassy open fields) for egg-laying.	**No Potential.** The shoreline of the Study Area is entirely developed and devoid of any undeveloped areas that may be suitable for nesting. Further the aquatic portions of the Study Area are comprised of brackish and tidal bays which are not suitable for this species.	No further action is necessary for this species.
FISH				
Chinook salmon - central valley fall/late fall-run ESU *Oncorhynchus tshawytscha*	SSC, RP, NMFS	Populations spawning in the Sacramento and San Joaquin Rivers and their tributaries. Adults migrate upstream to spawn in cool, clear, well-oxygenated streams. Juveniles remain in fresh water for 1 or more years before migrating downstream to the ocean.	**High Potential.** This species is known to occur within the Mare Island and Carquinez Straits seasonally as it migrates to and from natal streams and the ocean.	See section 5.2 for further discussion of this species.

SCIENTIFIC NAME	STATUS[1]	HABITAT	POTENTIAL FOR OCCURRENCE	RECOMMENDATIONS
Chinook salmon - Central Valley spring-run ESU *Oncorhynchus tshawytscha*	FT,ST	Occurs in the Feather River and the Sacramento River and its tributaries, including Butte, Mill, Deer, Antelope and Beegum Creeks. Adults enter the Sacramento River from late March through September. Adults migrate upstream to spawn in cool, clear, well-oxygenated streams from mid-August through early October. Juveniles migrate soon after emergence as young-of-the-year, or remain in freshwater and migrate as yearlings.	**High Potential.** This species is known to occur within the Mare Island and Carquinez Straits seasonally as it migrates to and from natal streams and the ocean.	See section 5.2 for further discussion of this species.
Chinook salmon – Sacramento winter-run ESU *Oncorhynchus tshawytscha*	FE, SE, RP, NMFS	Occurs in the Sacramento River below Keswick Dam. Spawns in the Sacramento River but not in tributary streams. Requires clean, cold water over gravel beds with water temperatures between 6 and 14 degrees C for spawning. Adults migrate upstream to spawn in cool, clear, well-oxygenated streams. Juveniles typically migrate to the ocean soon after emergence from the gravel.	**High Potential.** This species is known to occur within the Mare Island and Carquinez Straits seasonally as it migrates to and from natal streams and the ocean.	See section 5.2 for further discussion of this species.

SCIENTIFIC NAME	STATUS[1]	HABITAT	POTENTIAL FOR OCCURRENCE	RECOMMENDATIONS
Coho salmon - central CA coast ESU *Oncorhynchus kisutch*	FE, SE, NMFS	Federal listing includes populations between Punta Gorda and San Lorenzo River. State listing includes populations south of San Francisco Bay only. Occurs inland and in coastal marine waters. Requires beds of loose, silt-free, coarse gravel for spawning. Also needs cover, cool water and sufficient dissolved oxygen.	**No Potential.** This species is considered extirpated from San Francisco Bay and its tributaries (NMFS 2012).	No further action is necessary for this species.
Delta smelt *Hypomesus transpacificus*	FT, SE, RP	Lives in the Sacramento-San Joaquin estuary in areas where salt and freshwater systems meet. Occurs seasonally in Suisun Bay, Carquinez Strait and San Pablo Bay. Seldom found at salinities > 10 ppt; most often at salinities < 2 ppt.	**Moderate Potential.** This species is known to occur within the Mare Island Strait seasonally.	See section 5.2 for further discussion of this species.
green sturgeon, southern Distinct Population Segment *Acipenser medirostris*	FT, SSC	Spawn in the Sacramento River and the Feather River. Spawn at temperatures between 8-14 degrees C. Preferred spawning substrate is large cobble, but can range from clean sand to bedrock.	**Present**. This species is known to occur within the Mare Island Strait seasonally.	See section 5.2 for further discussion of this species.
longfin smelt *Spirinchus thaleichthys*	FC, ST, SSC, RP	Euryhaline, nektonic and anadromous. Found in open waters of estuaries, mostly in middle or bottom of water column. Prefer salinities of 15 to 30 ppt, but can be found in completely freshwater to almost pure seawater.	**High Potential.** This species is known to occur within the Mare Island Strait seasonally.	See section 5.2 for further discussion of this species.

SCIENTIFIC NAME	STATUS[1]	HABITAT	POTENTIAL FOR OCCURRENCE	RECOMMENDATIONS
Pacific lamprey *Entosphenus* (=*Lampetra*) *tridentatus*	SSC	Spawns between March and July in gravel bottomed streams in riffle habitat. Larvae drift downstream to areas of low velocity and fine substrates and are relatively immobile in the stream substrates.	**High Potential.** This species is known to migrate through this area when moving to and from spawning streams in both the Sacramento Rover and the Napa River.	See section 5.2 for further discussion of this species.
river lamprey *Lampetra ayresi*	SSC	Lower Sacramento River, San Joaquin River and Russian River. May occur in coastal streams north of San Francisco Bay. Adults need clean, gravelly riffles, Ammocoetes need sandy backwaters or stream edges, good water quality and temps < 25 degrees C.	**High Potential.** This species is known to migrate through this area when moving to and from spawning streams in both the Sacramento River and the Napa River.	See section 5,2 for further discussion of this species.
Sacramento perch *Archoplites interruptus*	SSC, RP	(Only within native range) Historically found in the sloughs, slow-moving rivers, and lakes of the Central Valley. Prefer warm water. Aquatic vegetation is essential for young. Tolerate wide range of physio-chemical water conditions.	**Unlikely**. This species is known to occur within sloughs and slow backwater areas. The Study Area is comprised of swift waters which continually exchange through the Carquinez Strait. Such areas are too turbulent for the species. .	No further action is necessary for this species.

SCIENTIFIC NAME	STATUS[1]	HABITAT	POTENTIAL FOR OCCURRENCE	RECOMMENDATIONS
Sacramento splittail *Pogonichthys macrolepidotus*	SSC, RP	Formerly endemic to the lakes and rivers of the Central Valley, but now confined to the Sacramento Delta, Suisun Bay and associated marshes. Occurs in slow-moving river sections and dead-end sloughs. Requires flooded vegetation for spawning and foraging for young. A freshwater species, but tolerant of moderate salinity (10-18 parts per thousand).	**High Potential.** This species is known to occur within the Mare Island Strait seasonally.	See section 5.2 for further discussion of this species.
steelhead - central CA coast DPS *Oncorhynchus mykiss irideus*	FT	Occurs from the Russian River south to Soquel Creek and Pajaro River. Also in San Francisco and San Pablo Bay Basins. Adults migrate upstream to spawn in cool, clear, well-oxygenated streams. Juveniles remain in fresh water for 1 or more years before migrating downstream to the ocean.	**High Potential.** This species is known to occur within the Mare Island Strait seasonally.	See section 5.2 for further discussion of this species.

SCIENTIFIC NAME	STATUS[1]	HABITAT	POTENTIAL FOR OCCURRENCE	RECOMMENDATIONS
steelhead - central valley DPS *Oncorhynchus mykiss irideus*	FT, NMFS	Includes all naturally spawned populations (and their progeny) in the Sacramento and San Joaquin Rivers and their tributaries, excluding San Francisco and San Pablo bays and their tributaries. Preferred spawning habitat is in cool to cold perennial streams with high dissolved oxygen levels and fast flowing water. Abundant riffle areas for spawning and deeper pools with sufficient riparian cover for rearing are necessary for successful breeding.	**High Potential.** This species is known to occur within the Mare Island Strait seasonally.	See section 5,2 for further discussion of this species.
tidewater goby *Eucyclogobius newberryi*	FE, SSC	Brackish water habitats along the California coast from Agua Hedionda Lagoon, San Diego County to the mouth of the Smith River. Found in shallow lagoons and lower stream reaches; requires fairly still but not stagnant water and high oxygen levels.	**No Potential.** This species is extirpated from the interior of San Francisco Bay (USFWS 2005).	No further action is necessary for this species.
white sturgeon *Acipenser transmontanus*	SSC	Found in most estuaries along the Pacific coast. Adults in the San Francisco Bay Estuary system spawn in the Sacramento River and are not known to enter freshwater or non-tidal reaches of Estuary streams. Spawn May through June.	**Present**. This species is known to occur within the Mare Island Strait.	See section 5.2 for further discussion of this species.

SCIENTIFIC NAME	STATUS[1]	HABITAT	POTENTIAL FOR OCCURRENCE	RECOMMENDATIONS
		INVERTEBRATES		
California freshwater shrimp *Syncaris pacifica*	FE, SE, RP	Endemic to Marin, Napa, and Sonoma counties. Found in low elevation, low gradient streams where riparian cover is moderate to heavy. Shallow pools away from main stream flow. Winter: undercut banks with exposed roots. Summer: leafy branches touching water.	**No Potential.** The Study Area does not contain freshwater streams which are required by the species.	No further action is necessary for this species.
conservancy fairy shrimp *Branchinecta conservatio*	FE, RP	Endemic to the grasslands of the northern two-thirds of the Central Valley; found in large, turbid pools. Inhabit astatic pools located in swales formed by old, braided alluvium; filled by winter/spring rains, last until June.	**No Potential.** The Study Area does not contain vernal pools required to support this species.	No further action is necessary for this species.
vernal pool fairy shrimp *Branchinecta lynchi*	FT, RP	Endemic to the grasslands of the Central Valley, central coast mountains, and south coast mountains, in astatic rain-filled pools. Inhabit small, clear-water sandstone-depression pools and grassed swale, earth slump, or basalt-flow depression pools.	**No Potential.** The Study Area does not contain vernal pools required to support this species.	No further action is necessary for this species.
		HABITATS		

SCIENTIFIC NAME	STATUS[1]	HABITAT	POTENTIAL FOR OCCURRENCE	RECOMMENDATIONS
Steelhead, Central California Coast Distinct Population Segment	Critical Habitat	Critical habitat for this species was designated under FR 58 FR 33212.	**Present.** Critical Habitat for this species is present within tidal portions of San Pablo Bay, including waters of the Study Area up to the high tide line.	See section 5.3 for further discussion of this specific habitat.
green sturgeon, southern Distinct Population Segment	Critical Habitat	Critical habitat for this species was designated under 74 FR 52300.	**Present.** Critical habitat for this species is present within aquatic portions of the Study Area up to the high tide line.	See section 5.3 for further discussion of this specific habitat.
Delta smelt	Critical Habitat	Critical habitat for this species was designated under 59 FR 65256.	**Absent.** Critical habitat for this species ends at the Carquinez Bridge, which is near, but outside of the Study Area.	No further action is necessary for this habitat.
Coastal Pelagic	Essential Fish Habitat	Essential Fisheries Habitat is designated under the Coastal Pelagic Species Fishery Management Plan (PFMC 2019)	**Present.** Essential fish habitat governed under this fisheries management plan is present within aquatic portions of the Study Area.	See section 5.3 for further discussion of this specific habitat.
Groundfish	Essential Fish Habitat	Essential Fisheries Habitat is designated under the Groundfish Fisheries Management Plan (PFMC 2022a)	**Present.** Essential fish habitat governed under this fisheries management plan is present within aquatic portions of the Study Area.	See section 5.3 for further discussion of this specific habitat.
Salmon (Chinook and Coho)	Essential Fish Habitat	Essential Fisheries Habitat is designated under the Coastal Pelagic Species Fishery Management Plan (PFMC 2022b)	**Present.** Essential fish habitat governed under this fisheries management plan is present within aquatic portions of the Study Area.	See section 5.3 for further discussion of this specific habitat.

[1] **California Native Plant Society. 2023. Inventory of Rare and Endangered Plants (online edition, v9.5). Sacramento, California. Online at: http://rareplants.cnps.org/; most recently accessed: February 2023.**

FE: Federal Endangered
FT: Federal Threatened
SE: State Endangered
ST: State Threatened
SR: State Rare
Rank 1A: Plants presumed extinct in California

Rank 1B:	Plants rare, threatened, or endangered in California and elsewhere
Rank 2:	Plants rare, threatened, or endangered in California, but more common elsewhere
Rank 3:	Plants about which we need more information – a review list
Rank 4:	Plants of limited distribution – a watch list

APPENDIX C. Representative Photographs

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Photo 1: Main pier structure used for docking of the TSGB. Looking to the east toward the Carquinez Strait.

Photo 2: Existing trestle as it approaches the shoreline. Trestle to remain in place.

Photo 3. Looking roughly southward from the shoreline into the existing boat basin. Boat basin is within the existing breakwater with the trestle to the left (orange arrow) and main pier in the background (yellow arrow). Boat basin is within existing maintenance dredge footprint.

Photo 4. Closer detail of piles under the trestle including sheetpiles which form the breakwater to protect the current boat basin.

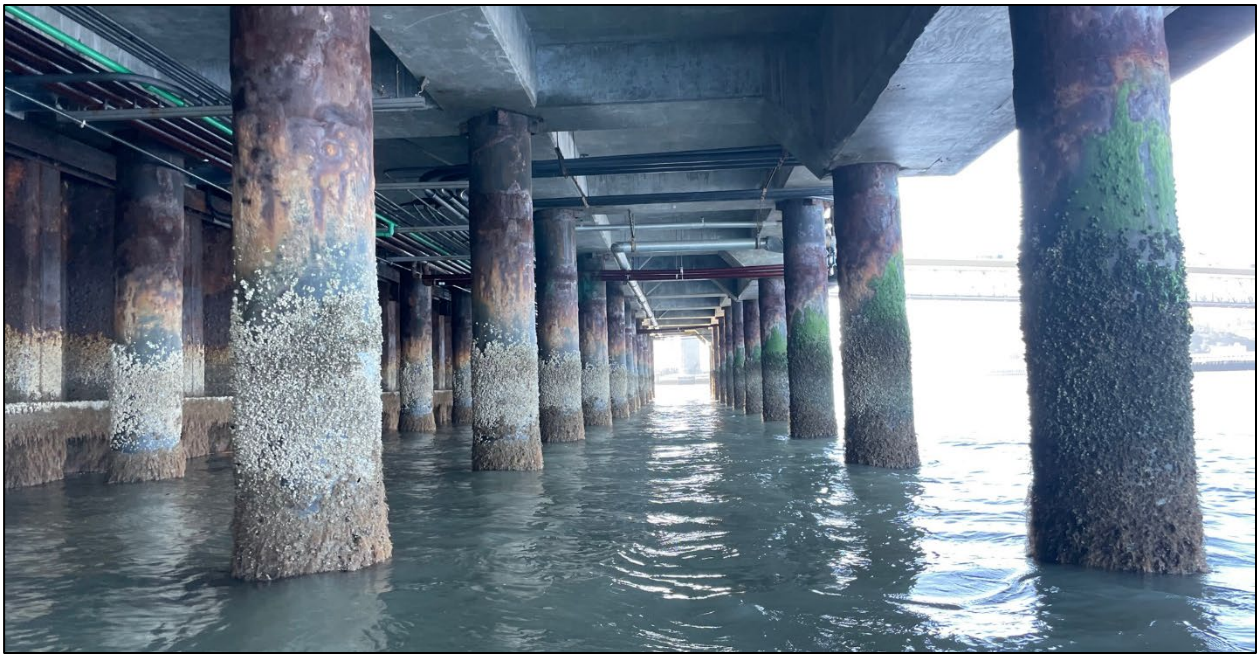


Photo 5. Beneath the main pier. The deck above is solid concrete to allow for heavy equipment and vehicles to load and unload cargo from the TSGB. A similar deck will be necessary for the new pier under the Proposed Project.

Photo 6. Sheetpiles like these will be placed along the new sections of pier to provide similar protections for the reconfigured boat Basin 1. Gaps in the sheetpile walls (arrow) allow water to flow out freely at multiple points in the wall which also allows fish to enter or exit in multiple areas but still offers protection from waves and surge which can damaged boats and docks.

Photo 7. Looking westward along the existing main pier where the TSGB would normally be docked. This pier will be demolished with a new, larger pier constructed on the outboard side (left).

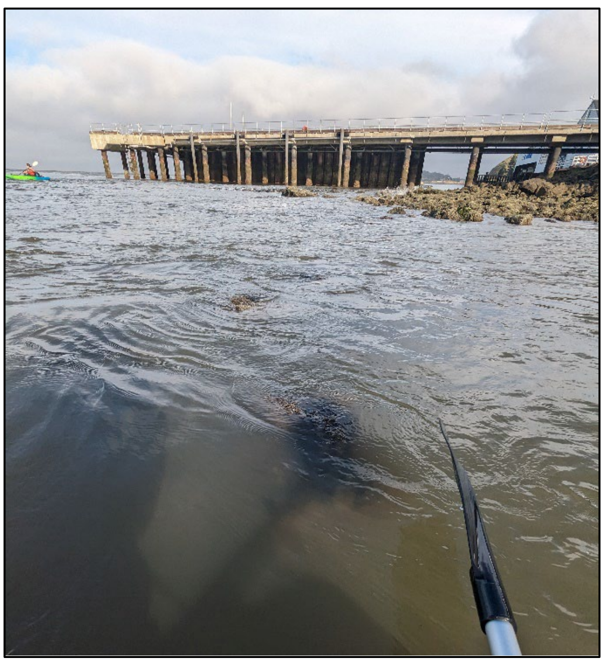


Photo 8. Looking westward showing the entire length of the existing trestle.

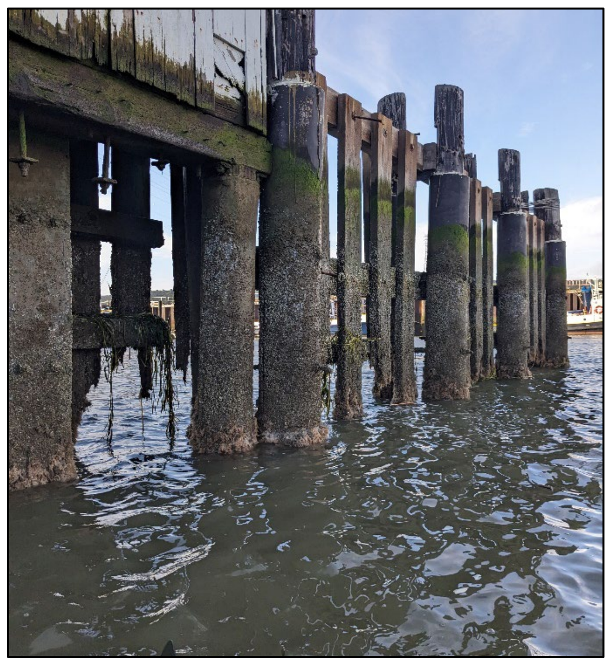


Photo 9. Existing breakwater around the boat basin showing dilapidated piles, and crumbling breakwater infrastructure which will be updated and replaced as one element of the project.

Appendix F

Cal Maritime Boathouse Historic Resource Evaluation

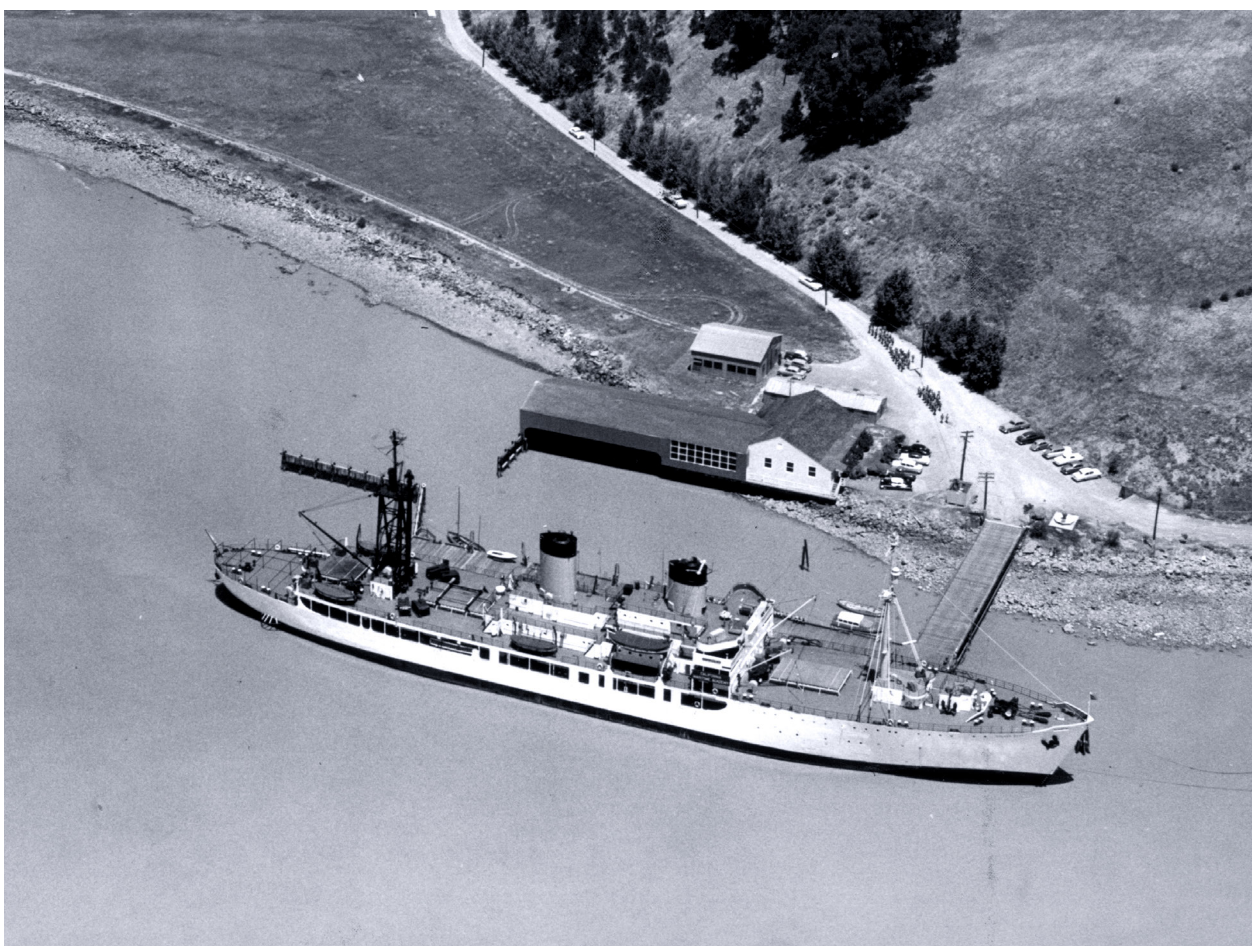
PAGE&TURNBULL

CAL MARITIME BOATHOUSE HISTORIC RESOURCE EVALUATION

VALLEJO, CALIFORNIA
[21067]

SUBMITTED TO
CALIFORNIA STATE UNIVERSITY MARITIME ACADEMY

January 24, 2024



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I. INTRODUCTION

This Historic Resource Evaluation (HRE) has been prepared at the request of the California State University Maritime Academy ("Cal Maritime") for the Boathouse building at the Cal Maritime campus in Vallejo, California. The Boathouse, which was completed in 1946 and was designed in a utilitarian style by the California Department of Public Works, Division of Architecture, is located at Morrow Cove where the Napa River and Carquinez Strait meet San Pablo Bay **(Figure 1)**. The Boathouse, which was historically also called the Seamanship Building, was dedicated in honor of Edwin C. Miller, a past graduate of and teacher at the Academy, and renamed the Edwin C. Miller Seamanship Center in 1989.

Figure 1: Aerial view of the Cal Maritime campus. The Boathouse is identified with a red arrow.
Source: Google Maps, 2021. Edited by Page & Turnbull.

Cal Maritime was originally established as the California Nautical School in 1929, was renamed the California Maritime Academy in 1939, and joined the California State University system in 1995, becoming the CSU Maritime Academy. The Cal Maritime campus was established at Morrow Cove in the 1940s and a permanent building campaign for the campus was started in 1943. Mayo Hall, which was constructed as a gymnasium and natatorium in 1945, was the first building to be erected on the site, and the Boathouse was completed the following year, in 1946.

The Boathouse has been in use as an educational building since its construction. It serves the Cal Maritime campus by storing the school's smaller boats; providing a location for maintenance and storage of small watercraft, sails, rigging, and tools; and includes small offices for staff and a workshop. The Boathouse also has a close connection to the waterfront and the adjacent wharf where Cal Maritime's Training Ship (currently the T.S. Golden Bear III) is regularly docked.

Methodology

This report follows a standard outline for Historic Resource Evaluation (HRE) reports, and provides a summary of the current historic status, a building description, and historic context for the Boathouse at Cal Maritime in Vallejo. Page & Turnbull prepared this report using research provided by the staff at Cal Maritime and shared by the Cal Maritime Campus History Center. Additional online sources that were consulted include HistoricAerials.com, UC Santa Barbara's FrameFinder Geospatial Collection, and Newspapers.com. Key primary sources consulted and cited in this report include Cal Maritime's Campus History Collection, historic photographs, records, past issues of Cal Maritime's yearbook *Hawsepipe,* and historical newspapers. Page & Turnbull staff conducted a site visit of the Boathouse on September 18 and November 22, 2021. All photographs within this report were taken on those dates, unless otherwise noted.

Summary of Findings

The Boathouse at Cal Maritime, as one of the earliest permanent structures established at the campus, appears to be significant for individual listing in the National Register and the California Register under Criterion A/1 (Events) as a building that was critical to the development and success of the new campus, and demonstrates the recognition of the importance of Cal Maritime in the support of national maritime industries. The Boathouse also serves an important role in demonstrating the vital connection between the campus and the waterfront.

II. EXISTING HISTORIC STATUS

The following section examines the national, state, and local historic status currently assigned to the Boathouse at the Cal Maritime campus in Vallejo.

National Register of Historic Places

The National Register of Historic Places (National Register) is the nation's most comprehensive inventory of historic resources. The National Register is administered by the National Park Service and includes buildings, structures, sites, objects, and districts that possess historic, architectural, engineering, archaeological, or cultural significance at the national, state, or local level.

The subject building is not currently listed in the National Register.

California Register of Historical Resources

The California Register of Historical Resources (California Register) is an inventory of significant architectural, archaeological, and historical resources in the State of California. Resources can be listed in the California Register through a number of methods. State Historical Landmarks and National Register-listed properties are automatically listed in the California Register. Properties can also be nominated to the California Register by local governments, private organizations, or citizens. The evaluative criteria used by the California Register for determining eligibility are closely based on those developed by the National Park Service for the National Register of Historic Places.

The subject building is not currently listed in the California Register.

California Historical Resource Status Codes

Properties listed or under review by the State of California Office of Historic Preservation are listed within the Built Environment Resource Directory (BERD) and are assigned a California Historical Resource Status Code (Status Code) of "1" to "7" to establish their historical significance in relation to the National Register of Historic Places (National Register) or California Register of Historical Resources (California Register).[1] Properties with a Status Code of "1" or "2" are either eligible for listing in the California Register or the National Register, or are already listed in one or both of the registers. Properties assigned Status Codes of "3" or "4" appear to be eligible for listing in either register, but normally require more research to support this rating. Properties assigned a Status Code of "5" have typically been determined to be locally significant or to have contextual

[1] California State Office of Historic Preservation, Built Environment Resource Directory (BERD), Solano County, updated March 2020.

importance. Properties with a Status Code of "6" are not eligible for listing in either register. Finally, a Status Code of "7" means that the resource has not been evaluated for the National Register or the California Register or needs reevaluation.

The subject building is not currently listed in the BERD database for Solano County with a status code. The most recent update to the BERD database for Solano County was in March 2020.

California State Historical Landmark

California State Historical Landmarks are sites, buildings, features, or events that are of statewide significance and have anthropological, cultural, military, political, architectural, economic, scientific or technical, religious, experimental, or other value.[2]

The subject building is not currently designated as a California State Historical Landmark.

Historic Status of Other Buildings at Cal Maritime

As part of preparation of the most recent 2018 Master Plan for the Cal Maritime campus, some of the other buildings on campus were evaluated for their eligibility as historic resources in the California Register in order for CSU to meet the requirements of CEQA and the Section 106 process. The Student Services Center Building and Mayo Hall and were preliminarily evaluated at that time.[3]

The Student Services Center Building, which was erected in the 1950s and subsequently altered, was not found to be eligible for the California Register under any criteria.

Mayo Hall, which is believed to be the first permanent building erected on the campus in 1945, was found to be eligible for the National Register and the California Register under both Criterion A/1 (Events) for its significant role in the establishment of the new campus, and under Criterion C/3 (Architecture) as a representative example of the Colonial Revival style. DPR forms were prepared for Mayo Hall in 2020 when California Public Resources Code (PRC) Section 5024 and 5024.5 consultation for a rehabilitation project at Mayo Hall was undertaken with the California Office of Historic Preservation (OHP).[4] This 2020 evaluation further stated that Mayo Hall does not appear to rise to the level of significance to qualify as eligible for designation as a California Historical Landmark.

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[2] California Office of Historic Preservation, "California Historical Landmarks Registration," accessed online January 4, 2024, https://ohp.parks.ca.gov/?page_id=21747#:~:text=Criteria%20for%20Designation&text=The%20first%2C%20last%2C%20only%2C,on%20the%20history%20of%20California.
[3] LSA, *Historic Resource Evaluation: Mayo Hall and Student Services Center Building, CSU Maritime*, February 2018, 28-33.
[4] Dudek, *Mayo Hall*, DPR 523A (Primary Record) and 523B (Building, Structure, and Object) forms, updated August 2020.

III. ARCHITECTURAL DESCRIPTION

The Cal Maritime Boathouse is located along Morrow Cove near the Carquinez Strait at the south end of the Cal Maritime campus **(Figure 2)**.

Figure 2: Boathouse at the Cal Maritime Academy campus. Building identified with dashed red line. Source: Google Maps, 2021. Edited by Page & Turnbull.

The building is not aligned to the cardinal directions, but for the ease and clarity of the building description, the façade that faces the bay and the wharf will be described as the west façade, the façade with the primary entrance will be described as the south façade, and so on.

The Boathouse is L-shaped in plan, with the primary entrance located on the south façade of the building, which sits on land, while the north end of the building projects over the water of Morrow Cove to allow for boat slips along the north end of the west façade. The one-story, wood-frame building sits on a foundation of wood piles on concrete footings; it is clad in a combination of painted wood shingles and painted vertical wood siding and has an asphalt shingle-clad cross-gable roof. The overall style of the building is utilitarian with decorative elements limited to the cross-brace pattern applied to the building's original wood doors.

The base of the building's L-shaped plan contains the primary entrance and "sail loft," where historically sails were cut, sewn, and repaired, beneath a steeply pitched side-gable roof. This section of the building is clad in painted wood shingles. The remaining length of the building, which will be referred to as the transverse wing, is clad in vertical painted wood siding and has a lower pitched roof. This area contains a work platform, boat slips, and some areas for storage and tooling.

Primary (South) Façade

The south façade contains the main entrance to the building and faces a small, paved parking area located immediately north of the dock. The original entrance door consists of a painted wood door with an applied cross-brace pattern. It is located at the west (left) end of the south façade but is currently not in use and blocked with a bench at the exterior **(Figure 3 and Figure 4)**. A small shed roof extends from the primary roof form over this entrance and has a wood paneled soffit with a ceiling-mounted light. To the west (left) of the entrance door, a wood staircase with a wood railing descends to a small wood walkway and dock along the west façade that extends over the water.

Figure 3: South façade of the Boathouse, looking northeast.

Figure 4: Detail of original primary entrance to the Boathouse, looking slightly northwest.

The remaining openings of the south façade consist of a single one-over-one vinyl replacement window to the east (right) of the original entrance door, a single leaf wood door that is currently used as the primary entrance door, and three evenly spaced one-over-one vinyl replacement windows **(Figure 5)**. A decorative dedication plaque is mounted to the east (right) of the current primary entrance door that reads “Edward C. Miller Seamanship Building.” A wood sign over the entrance reads “Boat House.”

Figure 5: Detail of east portion of the south façade. Looking northeast.

East Façade

The east façade of the sail loft portion of the Boathouse has a louvered vent centered within its gable peak and openings at the ground floor consist of two non-original partially glazed wood doors and two non-original, double-hung, one-over-one vinyl windows **(Figure 6 and Figure 7)**.

Figure 6: Detail of doors at east façade of the sail loft portion of Boathouse, looking south.

Figure 7: Oblique view of east façade of the sail loft portion of the Boathouse. Looking southwest.

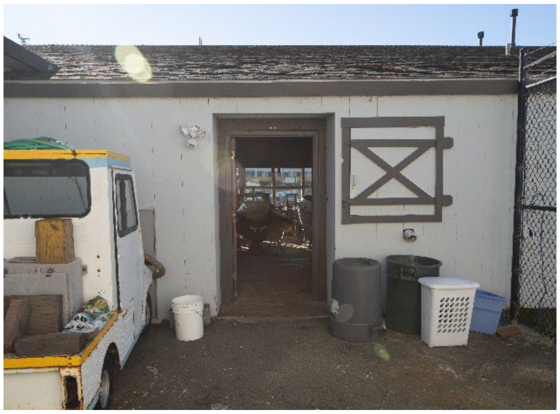

Figure 8: South end of the east façade of the transverse wing of the Boathouse, looking west.

Figure 9: East façade of the transverse wing of the Boathouse. Looking slightly southwest.

The transverse wing of the Boathouse has a single-leaf wood door within a recessed opening near its south end, a wood utility door with an applied cross-brace pattern to the north of the door, and four evenly spaced non-original aluminum slider windows along the remaining length of the building **(Figure 8 and Figure 9)**.

North Façade

The north-facing wall of the sail loft portion of the building has a single one-over-one vinyl replacement window **(Figure 10)**. The north façade of the transverse wing features a one-over-one vinyl replacement window at its east (left) side and a gridded window arrangement of fixed glazing that is three panels wide and four panels tall with painted wood mullions **(Figure 11)**.

Figure 10: North-facing wall of sail loft portion of Boathouse. Looking slightly southwest.

Figure 11: North façade of Boathouse, looking southwest.

West Façade

The west façade of the Boathouse along the transverse wing is open to the wharf and Morrow Cove for approximately half of its length to accommodate a number of boat slips **(Figure 12)**. The corners of this wide opening are clipped, and wood posts are visible that separate the boat slips and support the interior structure. The Cal Maritime logo and lettering reading "CAL MARITIME" is centered over this opening. To the south (right) of the opening for the boat slips is a large gridded window arrangement of eight windows wide and three windows tall with painted wood mullions.

The west façade of the sail loft of the Boathouse has a louvered vent centered within its gable peak and three evenly spaced one-over-one vinyl replacement windows **(Figure 13)**. A wall-mounted air conditioning unit is located near the south (right) corner of the west façade.

Figure 12: West façade of the Boathouse as seen from the Cal Maritime dock, looking east.

Figure 13: West façade of sail loft portion of the Boathouse. Looking slightly northeast.

Interior of Boathouse

As mentioned previously, the Boathouse consists of a sail loft, where historically sails were cut, sewn and repaired, and a transverse wing that contains the boat slips, work platform, and storage aisle **(Figure 14)**. The interior of the sail loft portion of the Boathouse has been divided into a number of small rooms including offices, workspaces, storage, and a kitchen **(Figure 15 to Figure 18)**. Some original wood doors with applied cross-braces are extant, including the door between the sail loft and the work platform and the door to the kitchen **(Figure 17 and Figure 18)**. Floors consist primarily of wood, but some areas within the sail loft portion of the building have applied linoleum tiles, including the kitchen, entrance lobby, some offices, and the bathroom. Lighting throughout the building consists of non-original, ceiling-mounted, fluorescent lighting. The kitchen and some offices along the midpoint of the building have drop ceilings.

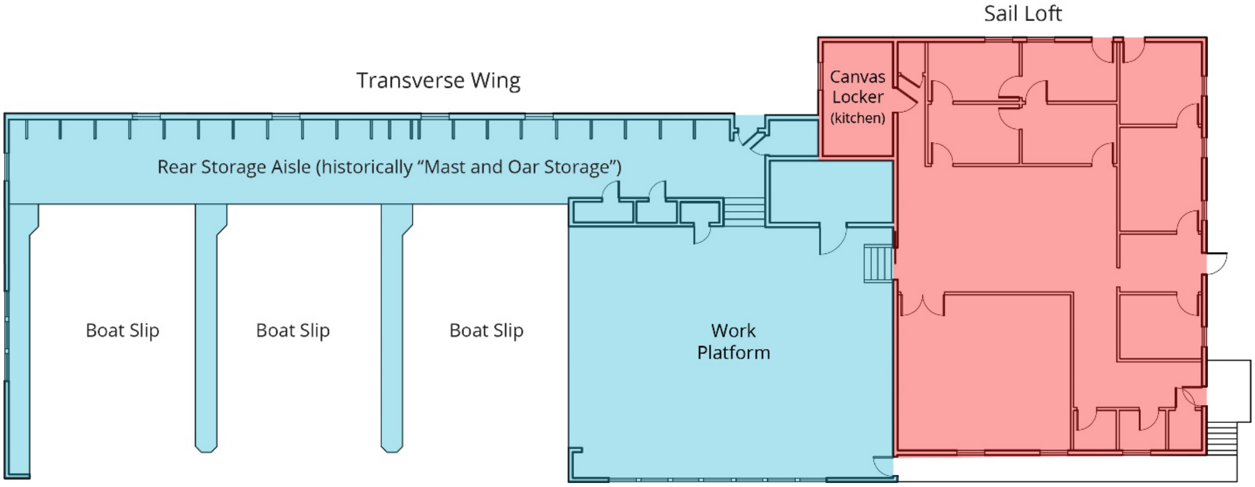

Figure 14: Floor plan of Boathouse, with transverse wing shaded blue and the sail loft including the canvas locker (now the kitchen) shaded red. Source: Page & Turnbull, based on original 1945 floorplan and measurements of existing partitions.

Figure 15: Looking slightly northwest from within the sail loft portion of the Boathouse.

Figure 16: Original door extant in sail loft portion of Boathouse.

Figure 17: Looking slightly northwest from within the sail loft portion of the Boathouse.

Figure 18: Original door extant in sail loft portion of Boathouse.

The transverse wing is divided into three areas including the boat slips, which fill the majority of the north end of the wing and are open to the exterior; a work platform that is positioned behind the windows of the west façade and connects to the sail loft with a small flight of wood steps and an original wood door with applied cross-bracing; and an elevated aisle along the east wall of the wing that is labeled as mast and oar storage on the original plans and used for general storage of rope, lifejackets, masts, oars, and other related material **(Figure 19, Figure 20, and Figure 21)**.

Figure 19: Looking north at the boat slips from the work platform. Note the yellow painted metal ladders from the rear storage area.

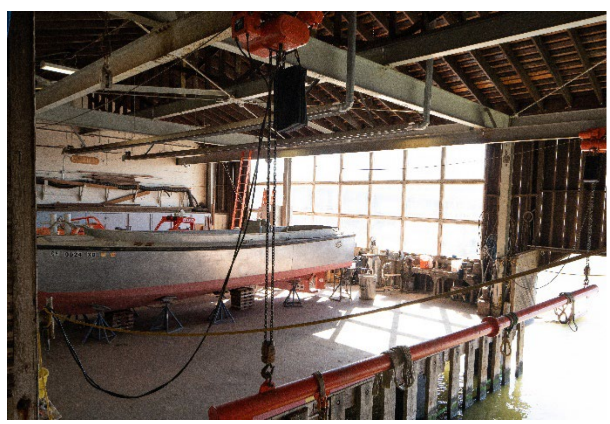

Figure 20: The work platform, as viewed from the elevated rear storage area, overlooking the south end of the boat slips. Looking southwest.

Figure 21: Looking south into the sail loft from the work platform.

Figure 22: Looking northeast from the work platform to the elevated storage area.

This elevated aisle is reached by wood stairs from the work platform and overlooks the boat slips **(Figure 22)**. A wood railing separates the elevated storage area from the boat slips, and small metal ladders along its west side provide access to the boat slips **(Figure 23)**. An enclosed section at the south end of the rear storage area houses a restroom and storage areas **(Figure 24)**. A notable feature of the transverse wing of the Boathouse is the exposed steel frame that supports the wood framed roof and connects to the foundation piers at key locations **(Figure 25)**.

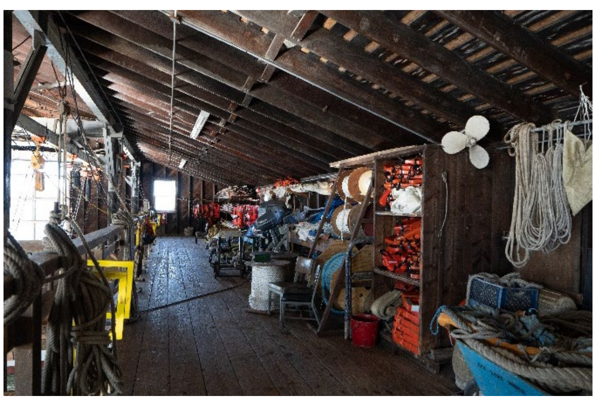

Figure 23: Looking north along the elevated rear storage area.

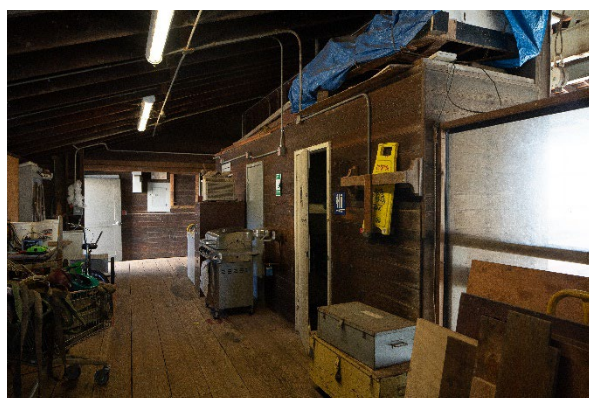

Figure 24: Looking south along the elevated rear storage area.

Figure 25: Looking southwest and up at metal framing of building.

Related Site Features

The Boathouse is located at the southern end of the Cal Maritime campus, and it is closely associated with the pier that has been present at this location since the early 1940s. The existing pier was constructed in 1995-1997, replacing a 1940s wood wharf, and features a concrete deck with timber piers, a steel-frame structure, and a steel sheet pile breakwater.[5]

A number of temporary buildings, sheds, and utility structures have been erected in the area of the Boathouse since its construction in 1946 **(Figure 26)**. This area, including the parking lot at the southeast end of the Boathouse, is currently blocked off with a metal fence and security station.

[5] Refer to "California Maritime Academy: Pier Extension" drawings, dated June 28, 1995.

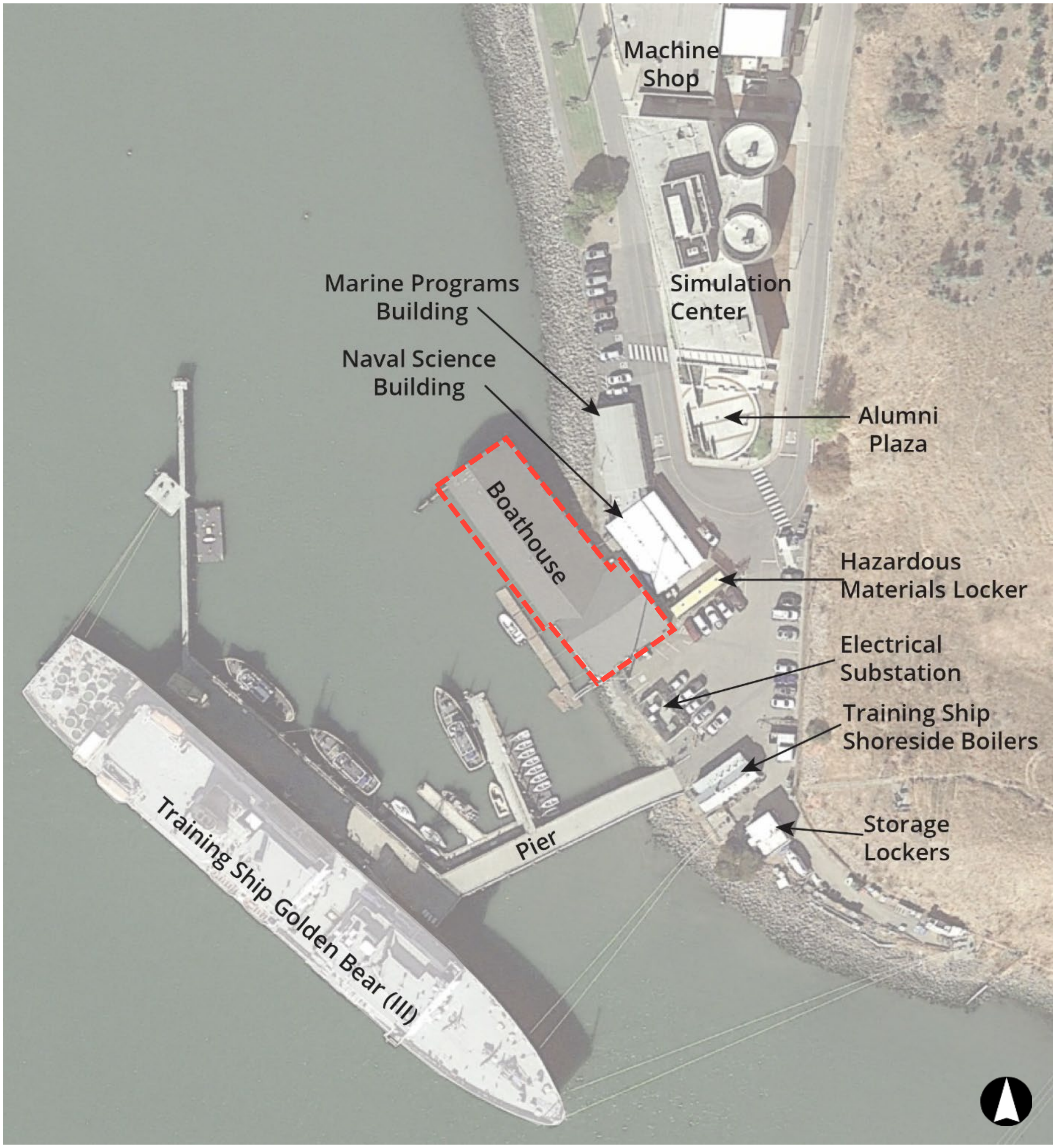

Figure 26: Buildings and structures located around the Boathouse (outlined with dashed red line). Source: Page & Turnbull. Base map: Google Earth aerial photograph, 2021.

IV. HISTORIC CONTEXT

Brief History of Morrow Cove Prior to 1940

Located at the mouth of the Carquinez Strait, Morrow Cove is now the southernmost tip of Vallejo, but until the construction of the Carquinez Bridge in 1927 this area remained remote from the growing city of Vallejo.

The following brief history of Morrow Cove is summarized from several sources including *A Brief History: The California Maritime Academy Historical Archives* written by archivist Doug Peterson for the 75th anniversary of the school, the Historic American Engineering Record (HAER) report on the Carquinez Bridge, historical newspaper articles, and various articles on the history of the campus that were included in *Hawsepipe,* the yearbook of Cal Maritime.[6]

Prior to the construction of the Carquinez Bridge in 1927, several ferries and automobile ferries operated along the Strait in order to allow navigation from Vallejo to the East Bay. Early automobile ferries that operated along the Strait include the Martinez-Benicia Ferry & Transportation Company in 1913, the Rodeo-Vallejo Ferry Company in 1918, and the Six-Minute Ferry in 1919, which operated between Morrow Cove and the town of Crockett.[7] Unfortunately, the Six-Minute Ferry's terminal at Morrow Cove was destroyed by a landslide in 1922. The Rodeo-Vallejo Ferry Company acquired the holdings of the Six-Minute Ferry and expanded its ferry business, which transported over one million passengers annually in approximately 400,000 vehicles in 1923 and 1924 **(Figure 27)**.[8]

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[6] Doug Peterson, *A Brief History: The California Maritime Academy Historical Archives,* CSU Maritime (website), Accessed September 21, 2021, https://www.csum.edu/about/media/cal-maritime-history-75th-anniversary.pdf; National Park Service, *Carquinez Bridge,* Historic American Engineering Record (HAER No. CA-297).
[7] George H. Harlan, *San Francisco Bay Ferryboats,* (Berkeley: Howell-North Books, 1967), 17.
[8] Charles Derleth. "Cantilever Highway Bridge Across Carquinez Strait." *Engineering News-Record*, September 24,1925, 504.

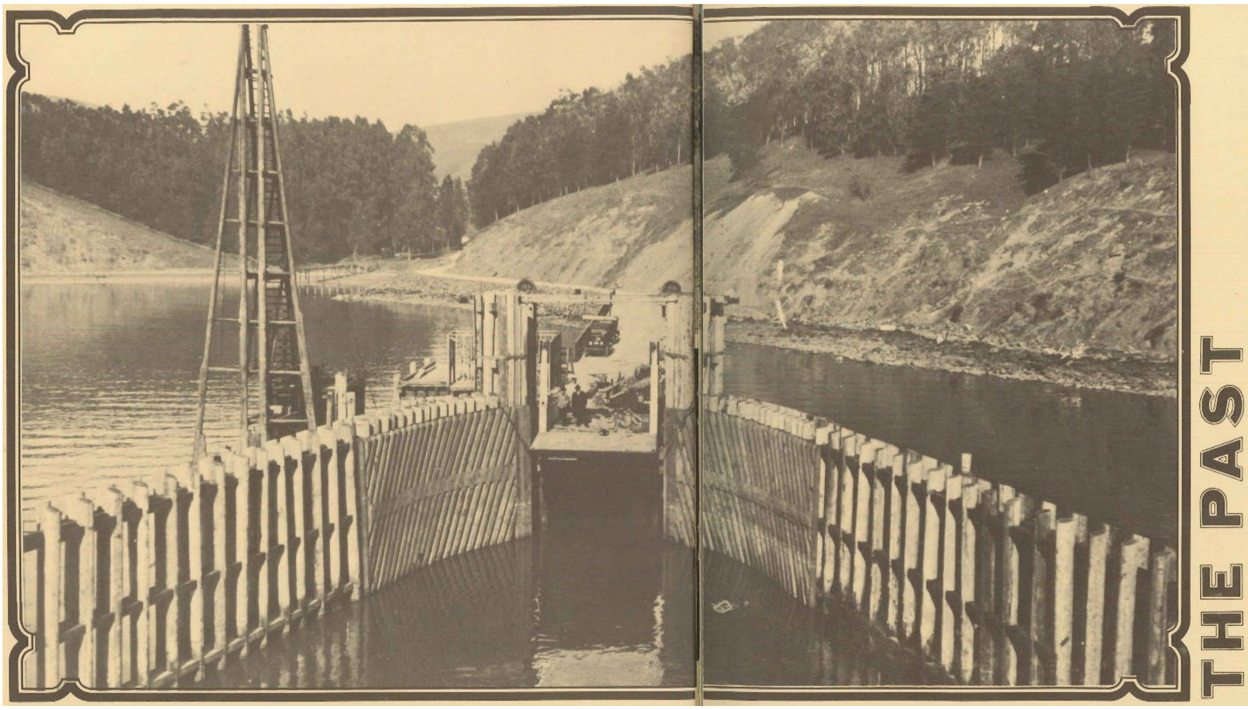

Figure 27: Undated photograph of the ferry slip at Morrow Cove where automobiles would be loaded onto the ferry to cross the Strait. Source: *Hawsepipe,* 1979.

The automobile ferry business was highly successful, but many drivers still chose to take the land route, consisting of an additional 30 miles, to avoid waiting for the ferry which struggled to meet the demand. Therefore, the owners of the Rodeo-Vallejo Ferry Company began to plan for the construction of a toll bridge to cross the Carquinez Strait and formed the American Toll Bridge Company. When the Carquinez Bridge opened in 1927, with its two main spans of 1,100 feet each, it had the second longest cantilever spans in the country and the fourth longest in the world.[9] In addition to its status as an engineering marvel, when completed, the Carquinez Bridge shortened the route from Sacramento to the Bay Area and was integrated into the transcontinental Lincoln Highway.

In the late 1920s, it appears that Morrow Cove had already become popular as a local fishing spot for bass, which feed in the area. By the early 1930s, the American Toll Bridge Company (who developed the Carquinez Bridge) sought to expand the appeal of the area and create a popular recreation area that would serve the citizens of Vallejo, the residents of the larger Bay Area who could now easily reach Morrow Cove for a day of leisure, and the tourists moving along the Lincoln Highway route. In 1933, the American Toll Bridge Company undertook a number of improvements including landscaping the Cove and installing a dance platform, playgrounds, picnic areas, and

[9] National Park Service, *Carquinez Bridge,* HAER No. CA-297, 22.

bathing facilities **(Figure 28)**.[10] Fishing clubs sprung up along the shoreline, and the Cove even had a small café to provide refreshments. Enhancing the swimming area was a significant man-made breakwater, in the form of two abandoned ships: the *Bangor,* a sailing schooner, and the *Contra Costa,* a ferryboat that transported railcars.[11]

Figure 28: View of recreation area at Morrow Cove in 1933. Source: *The Oakland Tribune,* May 1933.

At the beginning of U.S. involvement in World War II in December 1941, the California Department of Public Works issued an order to restrict access to Morrow Cove due to its proximity to the base of the Carquinez Bridge, which was seen as a strategic link between the "lower bay region and the Vallejo-Mare Island defense area."[12] This protective measure against possible sabotage of the bridge closed Morrow Cove to swimmers and fishermen in the 1940s. It is likely that public access to Morrow Cove remained restricted throughout World War II and allowed for this area to be considered as a possible location for the future Cal Maritime campus.

[10] "Morrow Cove Playground," *Oakland Tribune,* August 13, 1933, 10.; "New Bathing Beach Open on Carquinez Straits Today," *The San Francisco Examiner,* May 7, 1933.; "Morrow Cove Beach Opens Next Sunday," *Oakland Tribune,* April 30, 1933.
[11] Doug Peterson, unpublished manuscript on file at the Campus History Center.
[12] "State Acts to Ban Residents In Morrow Cove," *The Sacramento Bee,* December 9, 1941.

History of Cal Maritime

The following brief history of the early establishment of Cal Maritime, originally called the California Nautical School, has been excerpted from the 1979 volume of *Hawsepipe,* on the 50th Anniversary of the school.[13]

> California Maritime Academy was established [in 1929] by an Act signed into law by California Governor Young. This legislation was called the California Nautical School Act of 1929 and made possible the formation of a state owned school to train Engineering and Deck officers of the U.S. Merchant Marine. In 1931, after two years of preparations, the first group of midshipmen were enrolled at the California Nautical School's temporary campus at the U.S. Navy Coaling Station near Tiburon [in Marin County]. [....]
>
> But the fledgling California Nautical School soon faced serious financial and political problems and was in danger of being shut down. This period of uncertainty and hardship for the school started in 1933 and lasted for about six years. There were several attempts to close the California Nautical School due to an ailing national economy and an apparent drain on desperately needed government resources. Only through the efforts of many dedicated supporters were these attempts successfully circumvented and minimal funding was continued by the state.
>
> When news came in 1939 of a possible war with Germany, the Navy needed the Tiburon coaling station and the California Nautical School had to look for another location. After more than a year of searching and after the consideration of many sites for a campus, the Board of Governors of the school decided on Morrow Cove in Vallejo. The people of Vallejo were very much in favor of the proposition and gave the school some greatly needed support. During the interim, however, the school was first moved to Pier 54 in San Francisco, and then to the Ferry Building on Pier 2 a year later.
>
> The future of the California Nautical School began to look much better with the growing demand for Merchant seamen in the early 1940's. It was during this period, [...] that the California Nautical School was renamed the California Maritime Academy.[14] However, there were many delays and problems in trying to secure the expected $2.5 million estimated to develop the Morrow Cove site. In fact, after Pearl Harbor was attacked, the plans for construction of the new campus were almost completely dropped. In 1942, the Wartime Shipping Administration took over the

[13] *Hawsepipe,* 1979, 6-12.

[14] The adoption of the name California Maritime Academy occurred in 1939. This excerpt from *Hawsepipe* mistakenly lists the date as 1940, which appears to be incorrect based on other sources. It has therefore been omitted in this instance.

> Academy and through this agency, the original construction plans for Morrow Cove were revived.

Although the school was displaced from its Tiburon campus due to World War II, the California Maritime Academy continued to serve a critical role in the training and supplying of officers during the war. The educational program, which had introduced a three-year program for students to qualify for a merchant marine officer's license, was shortened to 18 months to supply trained officers more quickly.[15] Eleven graduates lost their lives in the line of duty during the war and were remembered at a dedication ceremony for Mayo Hall in 1946.[16] Immediately after World War II, the three-year program was restored, and the traditional training cruises were resumed. The school's annual training cruises, which provide students with hands-on experience navigating, piloting, maintaining, and running a ship, are held on the Cal Maritime Training Ship (T.S.), currently the T.S. Golden Bear III, which is on long-term loan from the United States Maritime Administration. The Academy has had four training ships: T.S. Golden State (1931–1946), T.S. Golden Bear I (1946–1971), T.S. Golden Bear II (1971–1995), and T.S. Golden Bear III (1996–present).[17] When not involved in the various cruises, the training ship is docked at the wharf adjacent to the Boathouse and provides additional educational facilities.

Despite the Academy's role in helping supply a trained Merchant Marine both during and outside of the war effort, the California Maritime Academy and the other state-run maritime academies were under threat of budget cuts and closures in the 1950s and in the 1970s. This was partially due to their complicated financial position where funding was supplied both from the federal government and each respective state legislature. In 1954, discussions on the need to crew the United States' vastly enlarged naval fleet strongly supported the ongoing funding of these institutions by the federal and state legislatures. In both instances, the value of these maritime academies was seen as essential to meeting the personnel needs of the merchant marine, the Coast Guard, and the Naval Reserve, in addition to staffing allied shipping industries – all industries that support the long-term maritime defense capabilities of the nation.[18]

Other notable milestones in Cal Maritime's history include the acceptance of women to the school in 1973, the establishment of a four-year college degree in the mid-1970s, and the full academic accreditation of the school in 1977.[19] In 1995, the California Maritime Academy became the 22nd

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[15] "State Maritime Academy Marks 25th Anniversary," *Sacramento Bee,* September 9, 1954, F1.
[16] Peterson, *A Brief History: The California Maritime Academy Historical Archives,* 8.
[17] Cal Maritime, "History of the Training Ship Golden Bear," *Cal Maritime* (website), Accessed November 30, 2021, https://www.csum.edu/about/tsgb/history.html
[18] "California's Academy," *Maritime Reporter,* October 1, 1952, 16.
[19] *Hawsepipe*, 1979, 19.

campus of The California State University (CSU) system, officially becoming California State University Maritime Academy.[20]

Additional context regarding the physical development of the Cal Maritime campus at Morrow Cove is addressed in the following section, titled **Site Development,** within **Section V. Site History.**

Brief Biography of Edwin C. Miller

The Boathouse was renamed and dedicated in 1989 in honor of Edwin C. Miller, a 1934 graduate of the California Nautical School (prior to the time it became known as Cal Maritime).

Miller enrolled at the California Nautical School in 1931 and graduated in 1934.[21] He briefly returned to the school to teach in 1935, after working as a Third Mate for the Grace Lines fleet. He appears to have remained actively involved with Cal Maritime into the early 1940s, despite a career with the U.S. Navy, and he was one of the members of the survey party that visited Morrow Cove in 1940 while looking for a new campus location.

During World War II, as part of his position in the Navy, Miller was assigned to teach seamanship and navigation to cadets at Cal Maritime. In 1945, Miller left his teaching post at the school to return to a full-time position with the Navy and did not retire until 1960. At that time, Miller returned to Cal Maritime to teach for the next nine years, retiring in 1969. In 1971, Miller briefly returned to Cal Maritime to serve as Interim President and was notably the first graduate of the school to then serve as its President.

Miller was well-regarded by the staff and students of Cal Maritime. He continued to be involved in the school through its Alumni Association (of which he was a charter member). In 1989, his many contributions to the school were recognized with the dedication and renaming of the Boathouse in his honor. Edwin C. Miller passed away in 1993.

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[20] Peterson, *A Brief History: The California Maritime Academy Historical Archives,* 13.
[21] This brief biography of Edwin C. Miller is largely based on the material included in “Did You Know…?” *Pacific Northwest News*, November 2009. A copy of this publication was provided to the author by the staff of the CSU Maritime Campus History Collection.

V. SITE HISTORY

Site Development

Morrow Cove was one of the many sites that was visited during the search for a new campus for the California Maritime Academy in the early 1940s. In December 1940, a survey party of administrators from Cal Maritime visited Morrow Cove, which had some piers, structures, and the remnants of the *Bangor* sailing schooner and the *Contra Costa* ferryboat **(Figure 29)**.

Figure 29: Photograph of Morrow Cove taken by Edwin C. Miller in December 1940, while at the site as part of a survey party of Maritime Academy administrators. Existing piers and structures were fully removed by 1946. At the far right is the *Contra Costa*, which served as a breakwater. Source: Cal Maritime, Campus History Collection.

As early as 1941, the 67-acre area along the shore of Morrow Cove was approved as the location of the new California Maritime Academy campus; but acquiring funding and navigating the political situation during World War II delayed the school's occupation of the site.[22] While piles were driven for a new pier as early as 1941, the site was not suitably completed for occupation by the school until August 1943 **(Figure 30)**. At this time, the *T.S. Golden State* was able to dock at the new wharf, and several temporary buildings provided facilities for students and teachers.[23] The site was developed in earnest in 1943 while the land was cleared, leveled, and graded and 330,000 cubic yards of earth were relocated from higher on the site to fill in a portion of the Cove.[24] At this time, the remnants of the hull of the *Bangor* were buried in the area that was infilled. Attempts to remove the hull of the *Contra Costa*, including refloating, towing, dredging, and dynamiting, all failed and

[22] Confusion around the federal agencies involved in the administration of the Merchant Marine was one of the factors that caused additional delay as Cal Maritime's campus project was placed under the jurisdiction of the Coast Guard and then subsequently reverted to the War Shipping Administration through an executive order by President Roosevelt. "Work Ordered on Maritime School at Morrow Cove," *Long Beach Sun,* July 10, 1942.

[23] The last temporary building from the early 1940s was removed in 1979. Refer to "1940s,"*Hawsepipe,* 1993, 51.

[24] "Sea Academy Contract is Let, *The Sacramento Bee,* November 4, 1943. This contract was let to A. Teichert & Company of Sacramento.; For number of yards of earth moved refer to: "The Interim Years: 1940-1943," *Hawsepipe,* 1963, 254.

elements of the hull remain extant and can be seen at low tide.[25] This process of infill extended the shoreline westward into the bay and created 12 additional acres of flat land along the shore.[26] Permanent structures were then added through phased construction.

Figure 30: View of the shoreline c. 1943 showing the completed wharf in the background with the *T.S. Golden State*. The old pier is partially extant, and the hulls of the *Contra Costa* and the *Bangor* are visible, prior to the regrading of the site. The Boathouse had not been constructed at this time. Source: *Hawsepipe*, 1979.

The construction program to erect permanent buildings on the campus was announced in early 1944 and started in September 1945 with the laying of a cornerstone for a gymnasium and natatorium (now called Mayo Hall).[27] This permanent building plan followed the guidance of a Master Development Plan developed by the California Department of Public Works, Division of Architecture, that proposed a symmetrical arrangement of buildings and pavilions that flanked a central Drill Field located along the shoreline **(Figure 31)**. The Master Plan showed a "Boat Shed" at the location of – and with a similar footprint to – the sail loft portion of the existing Boathouse; a separate sail loft building was proposed to be located north of the Boat Shed. The Master Development Plan appears to have helped guide the placement of some of the early facilities of the campus. However, the Boathouse – as it was constructed with its L-shaped footprint – did not adhere to the Master Development Plan. It was designed in 1945 and completed in 1946.[28]

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[25] Peterson, unpublished manuscript on file at the Campus History Center.
[26] "The Interim Years: 1940-1943," *Hawsepipe,* 1963, 254.
[27] "Maritime Academy Expansion Planned," *Oakland Tribune,* February 15, 1944, 11.; "California Maritime Academy," *Pacific Marine Review,* October 1945, 579.
[28] Refer to 1945 drawings of the Boathouse and Wharf. Supplied to the author by the administration of Cal Maritime.

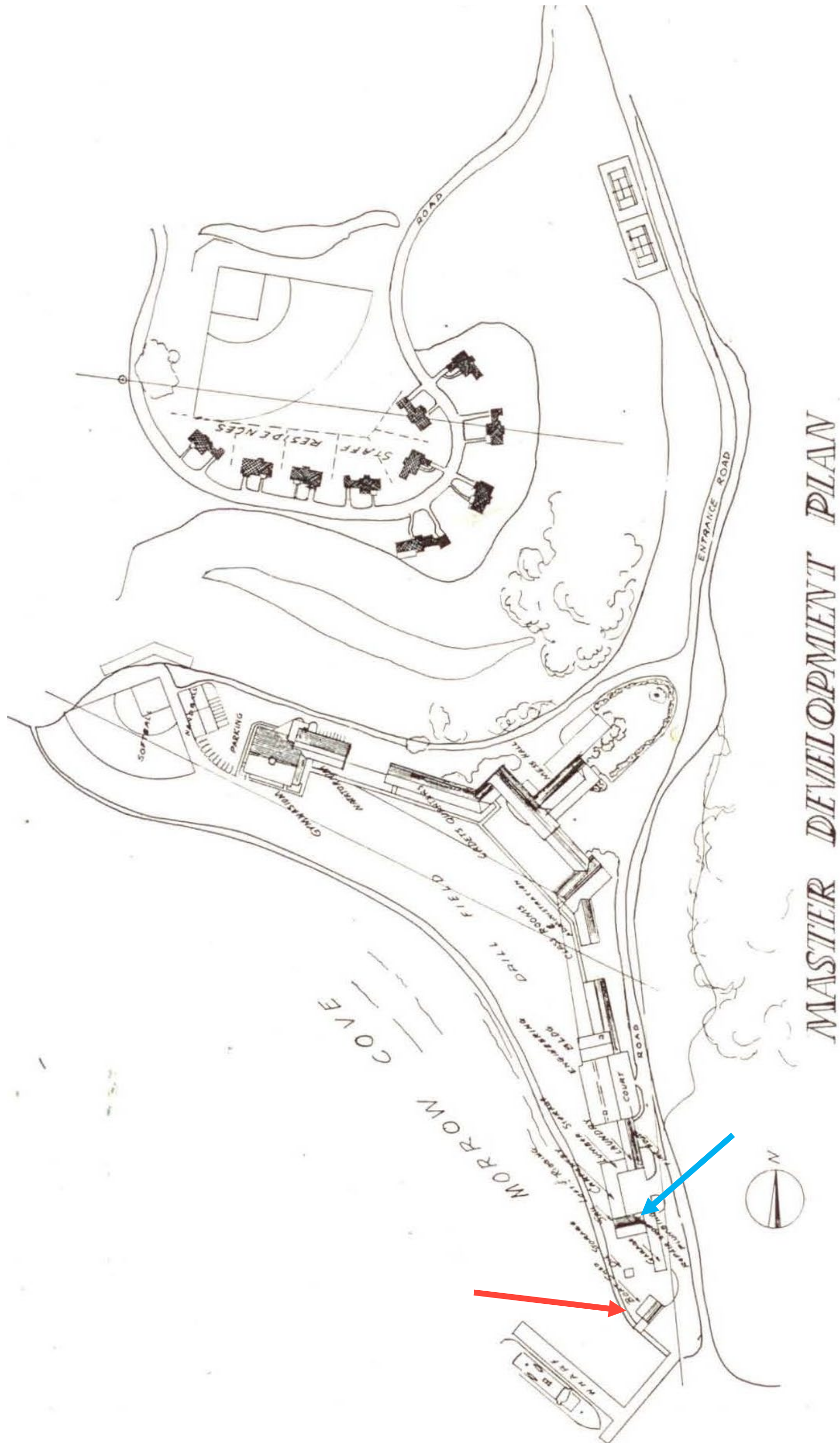

Figure 31: Master Development Plan for the Cal Maritime campus, c. 1945. Red arrow shows the location of the proposed Boat Shed; blue arrow shows the location of the proposed Sail Loft.
Source: *Pacific Marine Review,* October 1945. Edited by Page & Turnbull.

When completed, the Boathouse was used for "instruction in manila and wire splicing, canvas work, boat overhaul, and the reeving of blocks and tackles."[29] The campus remained relatively open along its southern end until the erection of Dwyer Hall, which was completed in 1960 and was the first large campus building located near the Boathouse **(Figure 32)**. Since that time, a number of new buildings have been erected at the campus, including the replacement of Dwyer Hall. Today, two modular buildings are located just east of the Boathouse – for Marine Programs and Naval Science – and the Simulation Center and the Steam Plant Simulator are located just north of that.[30]

Figure 32: Aerial photograph of the Cal Maritime campus with Vallejo in the background (top left of the image), c. 1961. *T.S. Golden Bear I* at the wharf. Source: Cal Maritime Campus History Collection.

[29] Committee on Efficiency and Cost Control, *The California Maritime Academy: Report of the Committee on Efficiency and Cost Control*, April 26, 1971, 4.
[30] LSA, *California State Maritime Academy, Physical Master Plan, Final Environmental Impact Report*, May 2018. Existing Facilities, Figure 3-3.

CONSTRUCTION CHRONOLOGY

Due to the ownership of the campus by the California State University system, building permits are not on file with the City of Vallejo. Beyond the original drawings of the Boathouse, the staff at Cal Maritime was unable to locate permits or drawings in their records that depicted alterations.

The Boathouse, as it appears today, is largely unaltered from its original form and design at the exterior, as illustrated by the 1945 drawings by the Department of Public Works, Division of Architecture and from mid- and late 1940s photographs **(Figure 33, Figure 34, and Figure 35)**. Along the interior, alterations have been made primarily to the south end of the building within the area historically called the sail loft. Alterations to the exterior and the interior are listed below.

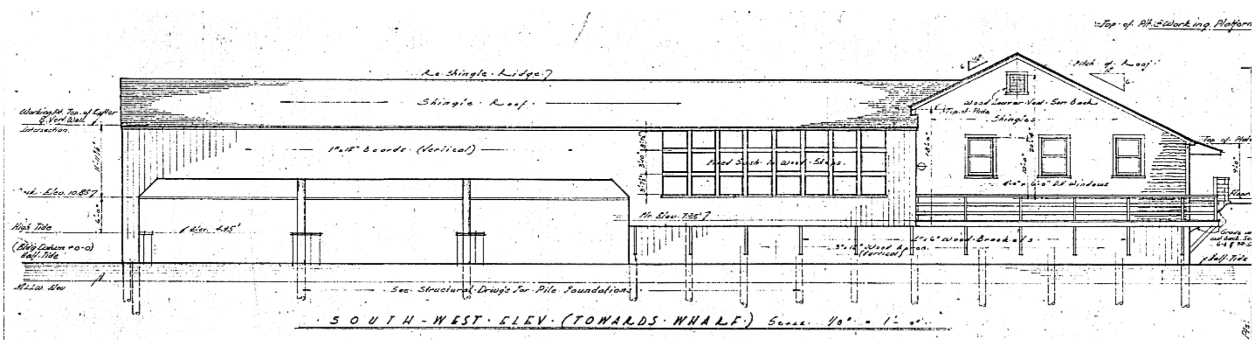

Figure 33: Detail of original drawing of Boathouse, dated December 1945. Source: Cal Maritime administration.

The following list of exterior alterations have occurred since the Boathouse was completed in 1946; alterations have been established through visual comparison between the original drawings from 1945, available historic photographs, and the Boathouse today.

- Reroofed at an unknown date, replacing the original wood-shingle roof
- Doors and windows installed along east façade of the sail loft portion of building after 1971 **(Figure 36)**
- Door installed at primary (south) façade between 1976 and 1989 **(Figure 37 and Figure 38)**
- Small aluminum slider windows installed at east façade of transverse wing at an unknown date[31]
- Edwin C. Miller dedication plaque installed circa 1989[32]

[31] A c. 1960s photograph in the collection of the CSU Maritime Campus History Collection offers a rare view of this rear façade and shows that no windows were present at that date. Refer to **Appendix B – Historic Photographs of the Boathouse**, **Figure 34**.

[32] Refer to *Hawsepipe*, 1989 or *Pacific Northwest News*, November 2009. Both sources describe the dedication of the Boathouse to Edwin C. Miller.

- Original one-over-one double-hung wood windows replaced with vinyl windows at all locations since 2008 **(Figure 39)**
- Fixed glazing of large window arrangements at west and north façades replaced in kind at an unknown date

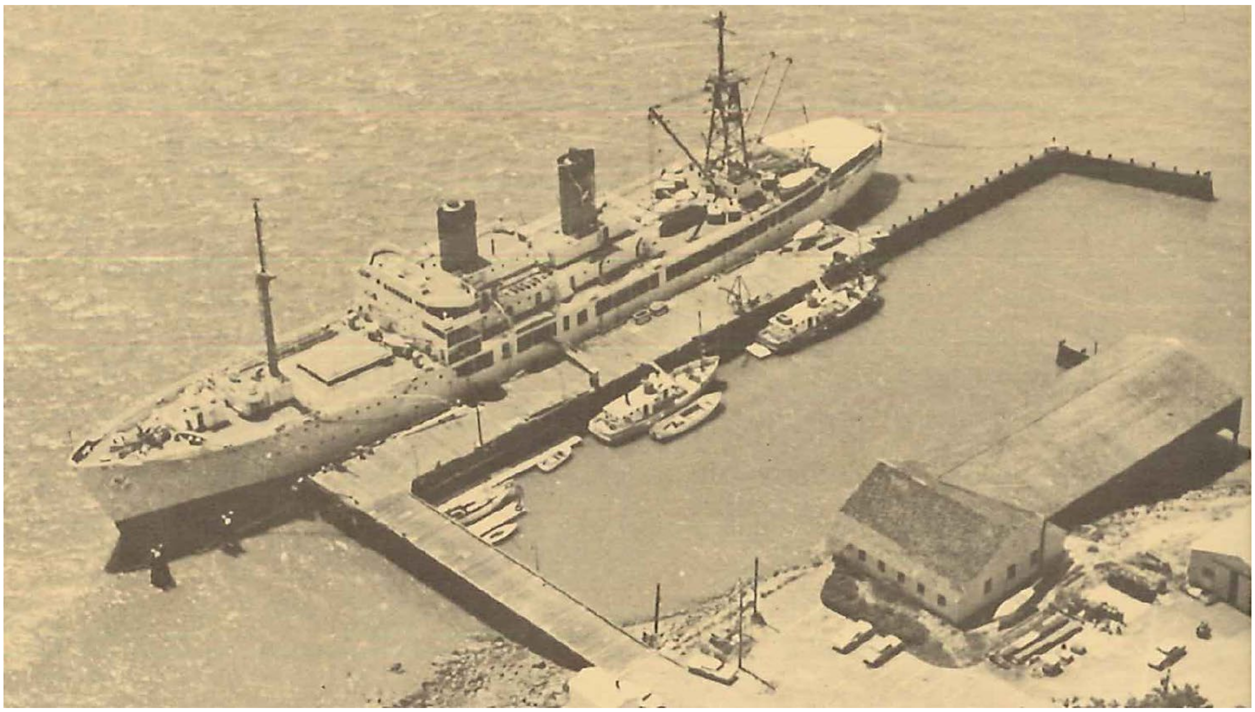

Figure 34: View of the Boathouse and docked ship, c. 1946.
Source: *Hawsepipe*, 1979, Cal Maritime Campus History Collection.

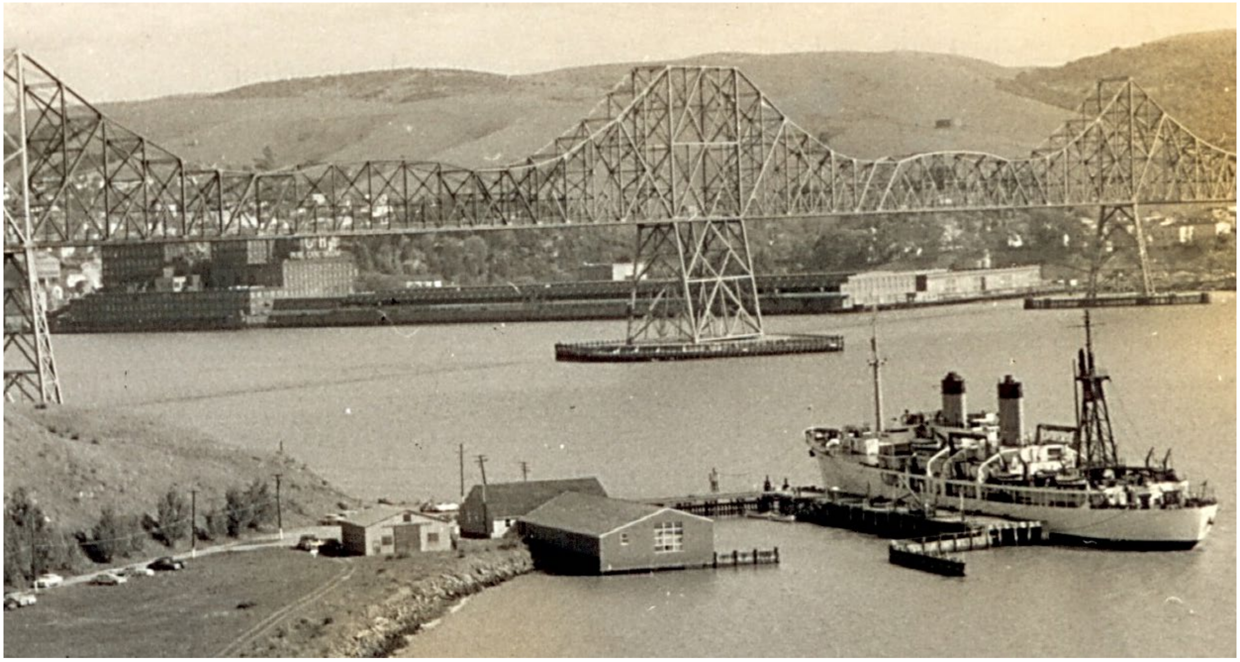

Figure 35: Looking south over the Boathouse and wharf, towards the Carquinez Bridge, c. 1948.
Source: Cal Maritime, Campus History Center.

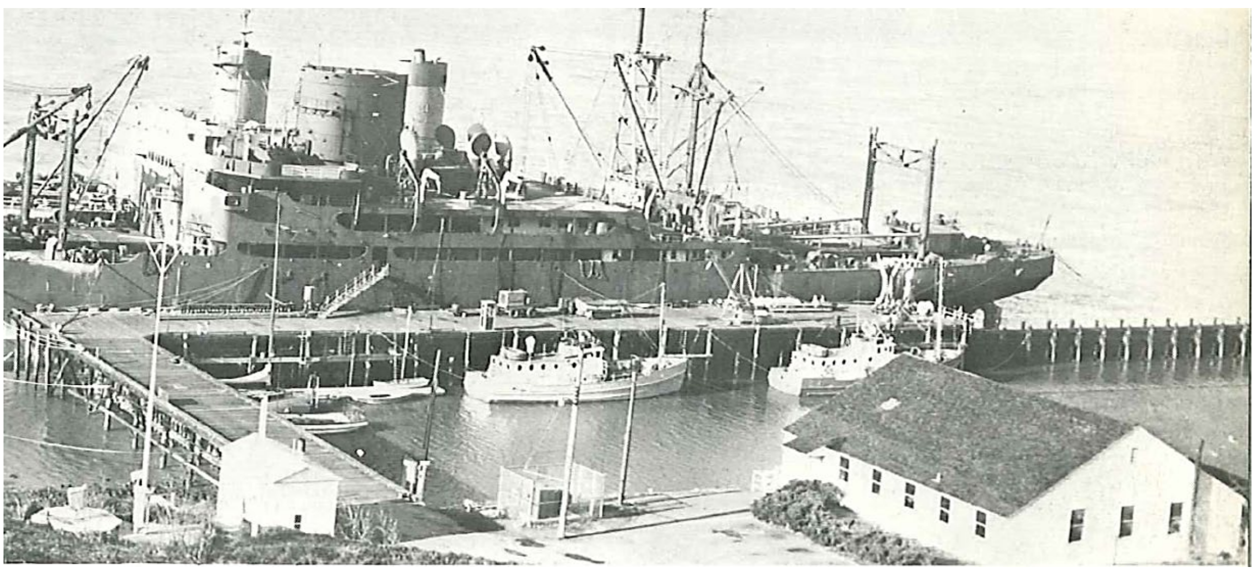

Figure 36: View of the Boathouse and wharf, c. 1971.
Source: *Hawsepipe*, 1971, Cal Maritime Campus History Collection.

Figure 37: View of Boathouse, 1976. Source: *Hawsepipe*, 1976, Cal Maritime Campus History Collection.

Figure 38: South façade of the Boathouse, door at far left of frame present by 1989.
Source: *Hawsepipe*, 1990, Cal Maritime, Campus History Collection.

Figure 39: View showing the west façade of the sail loft portion of the Boathouse, 2008.
Source: *Hawsepipe,* 2008, Cal Maritime, Campus History Collection.

The following list of interior alterations relates primarily to the sail loft portion of the Boathouse. All alterations were identified through visual observation of the existing conditions of the Boathouse's interior and a comparison with the original 1945 drawings of the building.

- Erection of several interior partitions within the sail loft for offices, an entrance vestibule, machine shop, storage areas, and restroom
- Installation of linoleum flooring in some offices
- Installation of drop ceilings in some offices along the east of the sail loft
- Installation of ceiling-mounted fluorescent lighting

Overall, the Boathouse remains largely unaltered in its original materials, form, use, and location.

VI. EVALUATION

National Register of Historic Places

The National Register of Historic Places (National Register) is the nation's most comprehensive inventory of historic resources. The National Register is administered by the National Park Service and includes districts, sites, buildings, structures, and objects significant in American history, architecture, archeology, engineering, and culture. These resources contribute to an understanding of the historical and cultural foundations of the Nation at the national, state, or local level. Typically, properties over fifty years of age may be eligible for listing in the National Register if they meet any one of the four significance criteria and if they retain sufficient historic integrity to convey that significance. However, properties under fifty years of age may be determined eligible if it can be demonstrated that they are of "exceptional importance." Other criteria considerations apply to cemeteries, birthplaces, graves of historical figures, properties owned by religious institutions or used for religious purposes, structures that have been moved from their original locations, reconstructed buildings, and properties primarily commemorative in nature. National Register criteria are defined in depth in *National Register Bulletin Number 15: How to Apply the National Register Criteria for Evaluation.*

The National Register has four basic criteria under which a property may be considered eligible for listing. It can be found significant under one or more of the following criteria:

- **Criterion A (Events):** Properties associated with events that have made a significant contribution to the broad patterns of our history;

- **Criterion B (Person):** Properties associated with the lives of persons significant in our past;

- **Criterion C (Architecture):** Properties that embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant distinguishable entity whose components lack individual distinction; and

- **Criterion D (Information Potential):** Properties that have yielded, or may be likely to yield, information important in prehistory or history.

A property may be considered significant on a national, state, or local level to American history, architecture, archaeology, engineering, and culture.

California Register of Historical Resources

The California Register of Historical Resources (California Register) is an inventory of significant architectural, archaeological, and historical resources in the State of California. Resources can be listed in the California Register through a number of methods. State Historical Landmarks and National Register-listed properties are automatically listed in the California Register. Properties can also be nominated to the California Register by local governments, private organizations, or citizens. The evaluative criteria used by the California Register for determining eligibility are closely based on those developed by the National Park Service for the National Register of Historic Places.
In order for a property to be eligible for listing in the California Register, it must be found significant under one or more of the following criteria.

- **Criterion 1 (Events):** Resources that are associated with events that have made a significant contribution to the broad patterns of local or regional history, or the cultural heritage of California or the United States.

- **Criterion 2 (Persons):** Resources that are associated with the lives of persons important to local, California, or national history.

- **Criterion 3 (Architecture):** Resources that embody the distinctive characteristics of a type, period, region, or method of construction, or represent the work of a master, or possess high artistic values.

- **Criterion 4 (Information Potential):** Resources or sites that have yielded or have the potential to yield information important to the prehistory or history of the local area, California, or the nation.

The following section examines the eligibility of the Boathouse for individual listing in the National Register and the California Register.

CRITERION A/1 (EVENTS)

The Boathouse at Cal Maritime was constructed from 1945-1946 and was one of the earliest permanent structures to be completed at Cal Maritime’s new campus at Morrow Cove. Other structures that had already been completed by this time include the original wood wharf and Mayo Hall. The Boathouse, in its use and its location along the waterfront, is closely associated with the establishment of the new campus. The creation of a purpose-built campus in the 1940s was a significant investment in the establishment of the California Maritime Academy that illustrated the important role that the school had played during World War II and recognized the importance of retaining and supporting the only degree-granting maritime academy on the West Coast.

The Boathouse was an important investment in the teaching facilities of the campus and, like Mayo Hall, was critical to the development of the permanent campus.[33] Additionally, the Boathouse is a unique element of the campus that is closely associated with the maritime nature of the Academy itself, and unlike the other buildings of the campus, provides a close connection to the water through its placement and its use. The Boathouse serves a key function as the location where small watercraft are stored, maintained, and repaired. It stores the necessary equipment to support the maritime activities of the students, including life jackets, oars, and sails, and supports the outfitting and running of the Training Ship. Therefore, the Boathouse appears to be eligible for the National Register and the California Register under Criterion A/1, with a period of significance that dates to 1946 and corresponds to the completion of the building.

CRITERION B/2 (PERSONS)

The Cal Maritime Boathouse is not associated with any individual person such that it would be individually eligible for the National Register or the California Register under Criterion B/2. The building has been owned and operated by the Cal Maritime since its construction and has been associated with many teachers and students since the 1940s. The building was dedicated to Edwin C. Miller in 1989 to recognize his many contributions to the school, which included his many years of teaching and a period as the Interim President of Cal Maritime. While the Boathouse was dedicated in his honor, the available material on Miller's career is not clearly associated with the Boathouse and it is not known whether he was particularly involved with the use of the Boathouse during his time as a teacher at Cal Maritime. As such, the Boathouse does not appear to be eligible for the National Register nor the California Register under Criterion B/2 for its association with any individuals.

CRITERION C/3 (ARCHITECTURE)

The Boathouse was designed in 1945 by the California Department of Public Works, Division of Architecture, and was completed in 1946. The building is relatively simple in its design as a utilitarian Boathouse that serves the Cal Maritime waterfront. The building has undergone some alterations to its exterior and interior, but remains largely intact in regard to its materials, form, and massing.

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[33] As mentioned in **Section II. Existing Historic Status: Historic Status of Other Buildings at Cal Maritime,** Mayo Hall was found significant under Criteria 1 and 3. The significance evaluation of Mayo Hall under Criterion 1 stated that "the building remains a visible and prominent remnant of the early formation of the California Maritime Academy and was crucial to the school's early development." The finding of the Boathouse as significant under Criterion 1 is consistent with the previous finding for Mayo Hall.

Along the exterior, alterations include the replacement of the roof, the replacement of all original double-hung wood windows with double-hung vinyl sash, the alteration to openings along the east façade where three windows were replaced with two doors and two windows, the installation of small aluminum slider windows along the east façade of the transverse wing, and the removal of an original window opening at the south façade to install a new entrance door. In areas where windows were replaced, the original openings have been retained and the replacement windows have matched the original design of a one-over-one double-hung window. At the interior, the sail loft portion of the Boathouse has been altered from its original form as a single open space with the erection of some partitions. Drop ceilings and linoleum flooring have been installed at some locations within the sail loft. Despite the Boathouse's retention of integrity (refer to the following section for analysis), it does not appear to be individually significant for its architecture as it is not a high-style example of a boathouse, nor was it designed by a master architect. Therefore, the Boathouse does not appear eligible for the National Register nor the California Register under Criterion C/3.

CRITERION D/4 (INFORMATION POTENTIAL)

The "potential to yield information important to the prehistory or history of California" typically relates to archeological resources, rather than built resources. When National Register and California Register Criterion D/4 (Information Potential) does relate to built resources, it is relevant for cases when the building itself is the principal source of important construction-related information. The analysis of the property at the Boathouse for eligibility under Criterion D/4 is beyond the scope of this report.

Integrity

In order to qualify for listing in any local, state, or national historic register, a property or landscape must possess significance under at least one evaluative criterion as described above and retain integrity. Integrity is defined by the California Office of Historic Preservation as "the authenticity of an historical resource's physical identity evidenced by the survival of characteristics that existed during the resource's period of significance," or more simply defined by the National Park Service as "the ability of a property to convey its significance."[34]

[34] California Office of Historic Preservation, *Technical Assistance Series No. 7: How to Nominate a Resource to the California Register of Historical Resources* (Sacramento: California Office of State Publishing, 4 September 2001) 11; U.S. Department of the Interior, National Park Service, *National Register Bulletin 15: How to Apply the National Register Criteria for Evaluation* (Washington, D.C.: National Park Service, 1995) 44.

Page & Turnbull used established integrity standards outlined by the *National Register Bulletin 15: How to Apply the National Register Criteria for Evaluation,* to evaluate whether the subject property retains sufficient integrity to convey its historic significance. Seven variables, or aspects, that define integrity are used to evaluate a resource's integrity—location, setting, design, materials, workmanship, feeling, and association. A property must possess most, or all, of these aspects in order to retain overall integrity. If a property does not retain integrity, it can no longer convey its significance and is therefore not eligible for listing in local, state, or national registers.

The seven aspects that define integrity are defined as follows:

> <u>Location</u> is the place where the historic property was constructed or the place where the historic event occurred;
>
> <u>Setting</u> addresses the physical environment of the historic property inclusive of the landscape and spatial relationships of the building(s);
>
> <u>Design</u> is the combination of elements that create the form, plan, space, structure, and style of the property;
>
> <u>Materials</u> refer to the physical elements that were combined or deposited during a particular period of time and in a particular pattern or configuration to form the historic property;
>
> <u>Workmanship</u> is the physical evidence of the crafts of a particular culture or people during any given period in history or prehistory;
>
> <u>Feeling</u> is the property's expression of the aesthetic or historic sense of a particular period of time; and
>
> <u>Association</u> is the direct link between an important historic event or person and the historic property.

Location

The Boathouse retains integrity of location, as it has remained situated at its location of original construction since 1946.

Setting

The Boathouse largely retains integrity of setting. The Boathouse was constructed close to the entrance to the pier at the south end of the Cal Maritime campus following the regrading of the campus in the mid-1940s. While many additional structures have been erected on the campus since the completion of the Boathouse, the Boathouse has retained its original connection to the shoreline of Morrow Cove and is closely associated with the maritime activities that take place along the wharf, including the docking of the training ship. The various additional structures that have been erected near the Boathouse are temporary and utilitarian in nature and do not overwhelm the 1946 building. These buildings and structures do not block access between the Boathouse and the historic location of the pier or its access to the water of Morrow Cove. Overall, the Boathouse retains its relationship to the shoreline and its setting within the larger Cal Maritime campus.

Design

The Boathouse was designed by the California Department of Public Works, Division of Architecture and has remained largely unaltered since its erection in 1946. The building retains its overall form, massing, and material palette, and therefore its original design as a 1946 boathouse.

Materials

The Boathouse retains integrity of materials. While the building has been reroofed with asphalt shingles, and its original double-hung wood windows have been replaced with vinyl sash, the building retains its overall materials with wood shingle and vertical wood siding, original wood doors, timber pier foundations, and internal steel framing.

Workmanship

The Boathouse was designed to serve a utilitarian function as an active boathouse for Cal Maritime and has minimal decorative features. Features providing evidence of period workmanship and construction methods include its structure, which sits over the water on timber piers, its vertical wood cladding and shingles, and its original wood doors with applied cross-bracing. The Boathouse retains its original materials and design elements that demonstrate the workmanship of the period.

Feeling

The Boathouse retains integrity of feeling as a working boathouse that was completed in 1946 to serve the students of Cal Maritime and provides an essential connection between the school and the waterfront of Morrow Cove. The building is closely identified with the maritime focus of the Academy, serves an integral function for the maintenance and storage of small watercraft, and provides a key educational space for the cadets of the Academy. The building retains its location and setting that directly relate to the feeling of the building as a boathouse, and the building continues to represent the early history of the Cal Maritime campus as it was just being established.

Association

The Boathouse retains its integrity of association with the early period of construction of the Cal Maritime campus and the maritime purpose of the Academy through the retention of the Boathouse's materials, design, setting, and feeling.

Overall, the Boathouse retains all seven aspects of integrity such that it conveys its significance under Criterion A/1, with a period of significance of 1946.

Character-Defining Features

For a property to be eligible for national or state designation under criteria related to type, period, or method of construction, the essential physical features (or character-defining features) that enable the property to convey its historic identity must be evident. These distinctive character-defining features are the physical traits that commonly recur in property types and/or architectural styles. To be eligible, a property must clearly contain enough of those characteristics to be considered a true representative of a particular type, period, or method of construction, and these features must also retain a sufficient degree of integrity. Characteristics can be expressed in terms such as form, proportion, structure, plan, style, or materials.

The character-defining features of the Boathouse include, but are not limited to:

Exterior Features

- Waterfront location with close relationship to the wharf
- Building partially extends over the water
- One-story volume with a cross-gable roof
- Dock at the west side of the sail loft portion of the building
- Wood walkway along the southwest edge of the building
- Mixture of wood shingle cladding and vertical wood cladding
- Original wood doors with an applied cross-brace pattern
- Large, gridded arrangements of fixed windows
- Evenly spaced window openings with the character of one-over-one double-hung window type along the south and west façades of the sail loft portion of the building
- Large opening for boat slips

Interior Features

- Two main volumes consisting of the sail loft and the transverse wing
- Organization of the transverse wing with its work platform, boat slips, and elevated rear storage aisle
- Original wood flooring throughout the building, including wood steps
- Original wood doors with applied cross-brace pattern (including the barn door between the sail loft and the transverse wing, and the door to the kitchen, originally the canvas locker)
- Wood railing and metal ladders between the elevated rear storage aisle and the boat slips

Features that are not character-defining features of the Boathouse consist of alterations that have been made to the building since its construction in 1946. These include, but are not limited to:

- Replacement windows (vinyl replacement windows are not historic)
- Non-original doors installed at the south and east façades
- Non-original windows installed at the east façade of the sail loft
- New openings with aluminum slider windows located at the east façade of the transverse wing
- In-wall air conditioning unit at the west façade

California State Historical Landmark

California State Historical Landmarks are sites, buildings, features, or events that are of statewide significance and have anthropological, cultural, military, political, architectural, economic, scientific or technical, religious, experimental, or other value. Nominated by the State Historic Resources Commission, all properties listed as a California State Historical Landmark are automatically listed on the California Register. All landmarks must address one of the following criteria for designation:

1. The first, last, only, or most significant of its type in the state or within a large geographic region (Northern, Central, or Southern California).

2. Associated with an individual or group having a profound influence on the history of California.

3. A prototype of, or an outstanding example of a period, style, architectural movement, or method of construction or is one of the more notable works or the best surviving work in a region of a pioneer architect, designer, or master builder.[35]

CRITERION 1

Cal Maritime, originally known as the California Nautical School, was established in 1929 and accepted its first students in 1931, operating temporarily from the U.S. Navy Coaling Station near Tiburon in Marin County until 1939. With the onset of World War II, the school was temporarily relocated to several pier buildings in San Francisco before construction plans for its permanent campus on Morrow Cove in Vallejo came to fruition between 1942 and 1945. Cal Maritime was the first, and remains to be the United States' only, maritime academy located on the West Coast. The propagation of the school through the 1940s reiterates its critical role in the training and supplying of naval officers and its unique proximity to American maritime defense operations in the Pacific region during World War II.

Completed in 1946, the Boathouse was the second-constructed building at the new Vallejo campus (shortly after Mayo Hall in 1945) and was important to the school's ongoing development and success. The building is illustrative of the vital connection between the campus, its curriculum, and the waterfront. However, the Boathouse is not the first, last, only, or most significant of its type in the state or within Northern California and does not carry the necessary level of significance as an individual building to be recommended as eligible for listing as a California State Historical Landmark under Criterion 1.

CRITERION 2

The Boathouse at Cal Maritime does not have a significant association with any individual person or group having a profound influence on the history of California. It has been associated with many teachers and students since the 1940s. It was dedicated to retired U.S. Naval Commander Edwin C. Miller in 1989 in recognition of his ongoing relationship with and many contributions to the school, including his years as a student (class of 1934), teacher, and Interim President (1971 – 1972). However, Miller's career is not directly associated with the Boathouse building within the Cal Maritime campus, and this name dedication appears to simply be in his honor. Therefore, the Boathouse does not appear to be eligible for individual listing as a California State Historical Landmark under Criterion 2.

[35] California Office of Historic Preservation, "California Historical Landmarks Registration," accessed online January 4, 2024, https://ohp.parks.ca.gov/?page_id=21747#:~:text=Criteria%20for%20Designation&text=The%20first%2C%20last%2C%20only%2C,on%20the%20history%20of%20California.

CRITERION 3

The Boathouse at Cal Maritime is not a prototype of nor an outstanding example of a period, style, architectural movement, or method of construction. It was designed in 1945 in a utilitarian style by the California Department of Public Works, Division of Architecture to serve as an educational building and small boat storage and maintenance facility for the campus. It is not a notable work nor a best surviving example of a pioneer architecture, designer, or master builder of the region. Completed in 1946, the building has undergone some alterations to both its exterior and interior, but remains largely intact in regard to its materials, form, massing, and relationship to the waterfront of Morrow Cove and an adjacent pier (reconstructed in 1995-1997 to replace the 1940s wood wharf) where Cal Maritime's training ship is regularly docked. While the Boathouse building was critical to the overall development and success of the relocated Cal Maritime campus (from Tiburon, Marin County to Vallejo, Solano County circa 1942), it is not a unique representative of an architectural movement. Therefore, the Boathouse does not appear eligible for listing as a California State Historical Landmark under Criterion 3.

VII. CONCLUSION

Cal Maritime was originally established as the California Nautical School in 1929 and was one of four degree-granting maritime academies operating in the United States. The school was renamed the California Maritime Academy in 1939, and joined The California State University system in 1995, becoming the California State University Maritime Academy. The establishment of the current campus at Morrow Cove in Vallejo was a significant investment by the state and federal government during World War II that illustrated the growing need to train maritime officers who go on to careers in the nation's maritime industries, whether that is related to naval defense or the merchant marine. The Cal Maritime campus was established at Morrow Cove in the 1940s with a permanent building campaign started in 1943.

The Boathouse, as one of the earliest permanent structures established at the campus, appears to be significant for individual listing in the National Register and the California Register under Criterion A/1 (Events) as a building that was critical to the development and success of the new campus and demonstrates the recognition of the importance of Cal Maritime in the support of national maritime industries. The Boathouse also serves an important role in directly demonstrating the connection of the campus to the waterfront in a way that other early permanent buildings on the campus, like Mayo Hall, do not. Under Criterion A/1, the Boathouse has a period of significance of 1946, corresponding to the year the building was completed. The Boathouse does not appear to be eligible for individual listing as a California Historical Landmark under any criteria.

The Boathouse appears to be an individual historic resource for the purposes of CEQA, California Public Resources Code (PRC) 5024 review, and Section 106 review.

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HistoricAerials.com

Newspapers.com

IX. APPENDICES

Appendix A – Significance Diagrams

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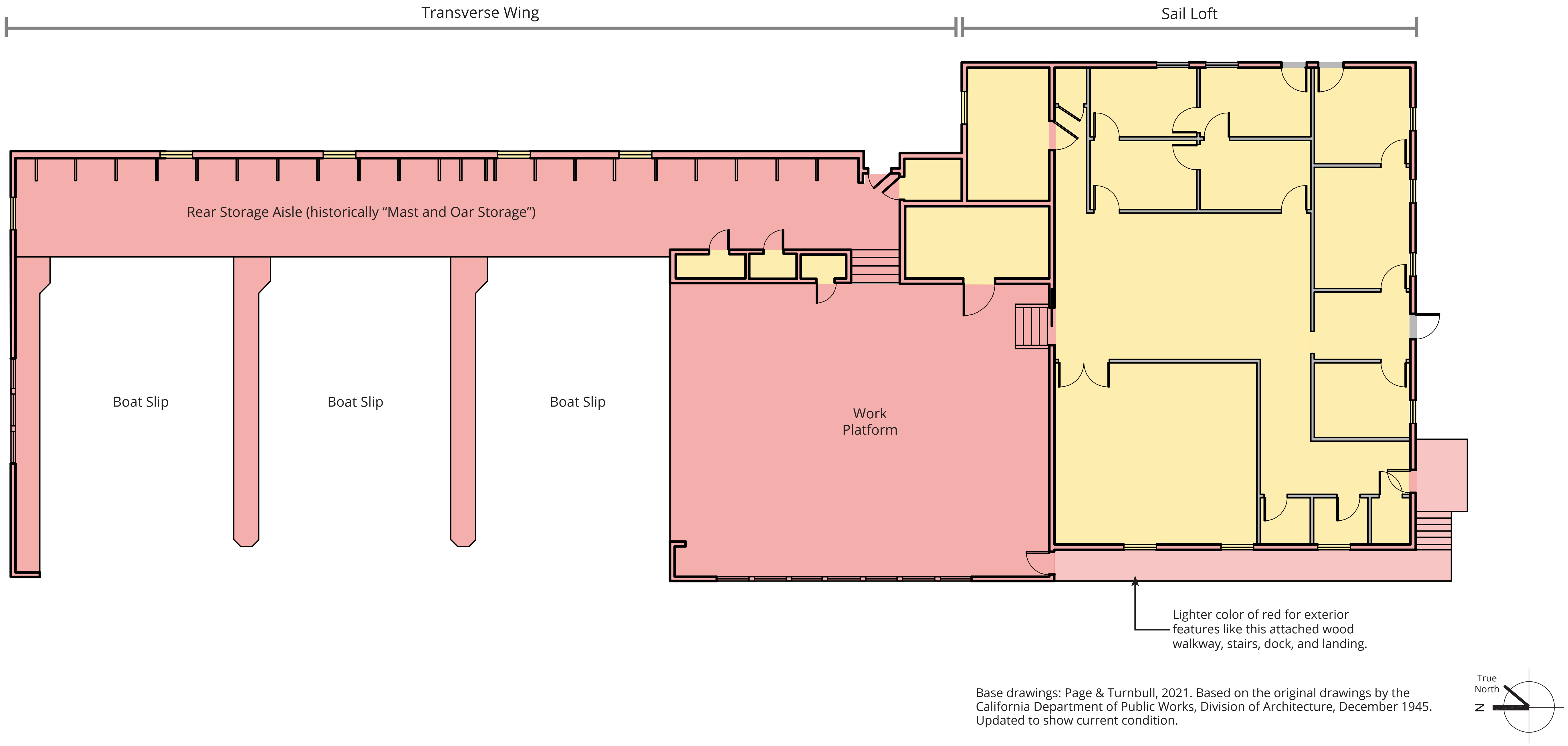
CATEGORIES OF SIGNIFICANCE

PRIMARY SIGNIFICANCE
Features or spaces that date to the period of significance (1946) and are the most historically significant components of the building.

CONTRIBUTING
Features or spaces that date to the period of significance (1946) and cumulatively contribute to the historic character of the building. These features are characterized by a lesser degree of significance or have been slightly altered.

NON-CONTRIBUTING
Features or spaces that were constructed after the period of significance (post-1946), have been significantly altered, or do not contribute to the overall historic character of the building. These features are not considered historic.



Base drawings: Page & Turnbull, 2021. Based on the original drawings by the California Department of Public Works, Division of Architecture, December 1945. Updated to show current condition.

Significance Diagrams

CAL MARITIME BOATHOUSE - VALLEJO, CA

PAGE & TURNBULL

CATEGORIES OF SIGNIFICANCE

PRIMARY SIGNIFICANCE
Features or spaces that date to the period of significance (1946) and are the most historically significant components of the building.

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Features or spaces that date to the period of significance (1946) and cumulatively contribute to the historic character of the building. These features are characterized by a lesser degree of significance or have been slightly altered.

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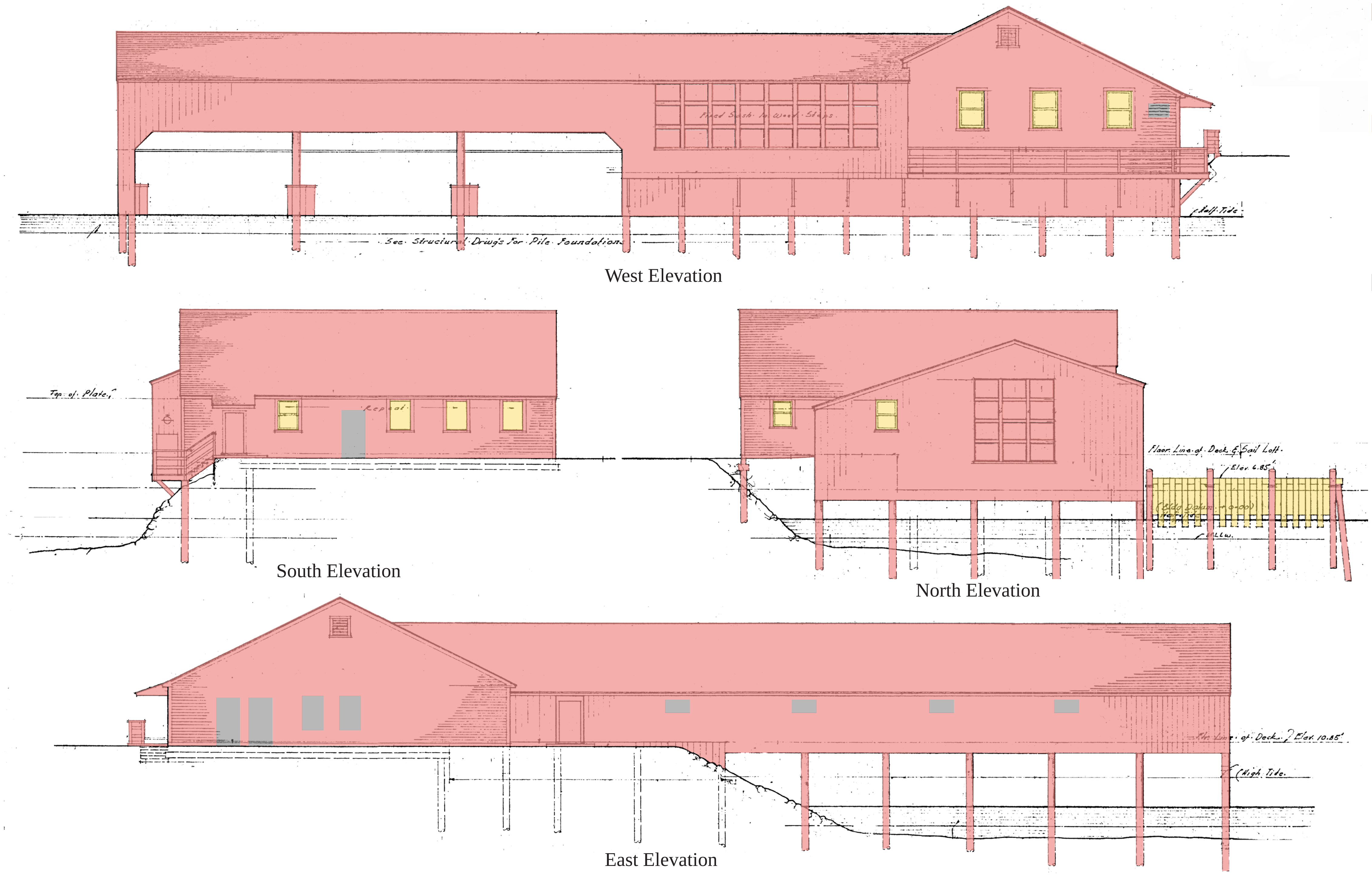
Features or spaces that were constructed after the period of significance (post-1946), have been significantly altered, or do not contribute to the overall historic character of the building. These features are not considered historic.

Base drawings: California Department of Public Works, Division of Architecture, December 1945. Updated by Page & Turnbull, 2021.



Significance Diagrams

CAL MARITIME BOATHOUSE - VALLEJO, CA

P&T
PAGE&TURNBULL

Appendix B – Historic Photographs of the Boathouse

Figure 40: View of the Cal Maritime campus, 1946. Source: *Hawsepipe*, 1946, Cal Maritime Campus History Collection.

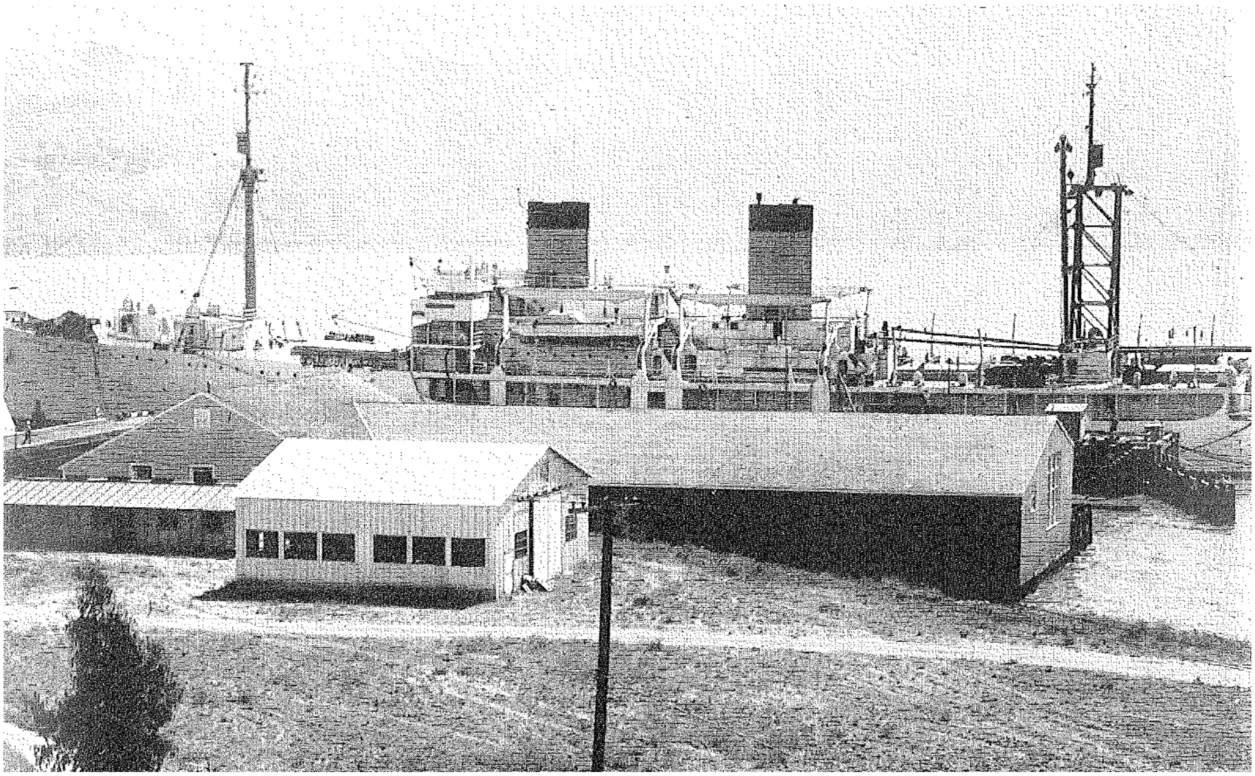


Figure 41: View of the Boathouse and wharf, 1949.
Source: *Hawsepipe*, 1949, Cal Maritime Campus History Collection.

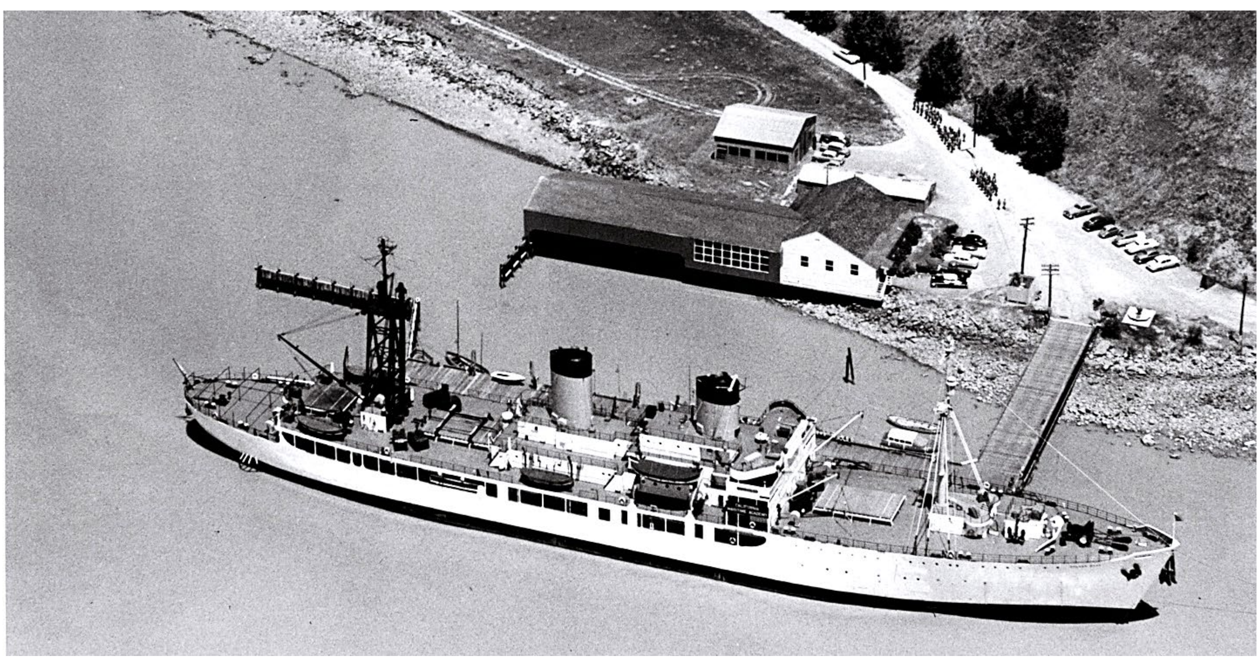


Figure 42: Aerial view of the Cal Maritime campus, 1957. Source: Cal Maritime Campus History Collection.

Figure 43: View of the Boathouse, 1958. Source: Cal Maritime, Campus History Collection.

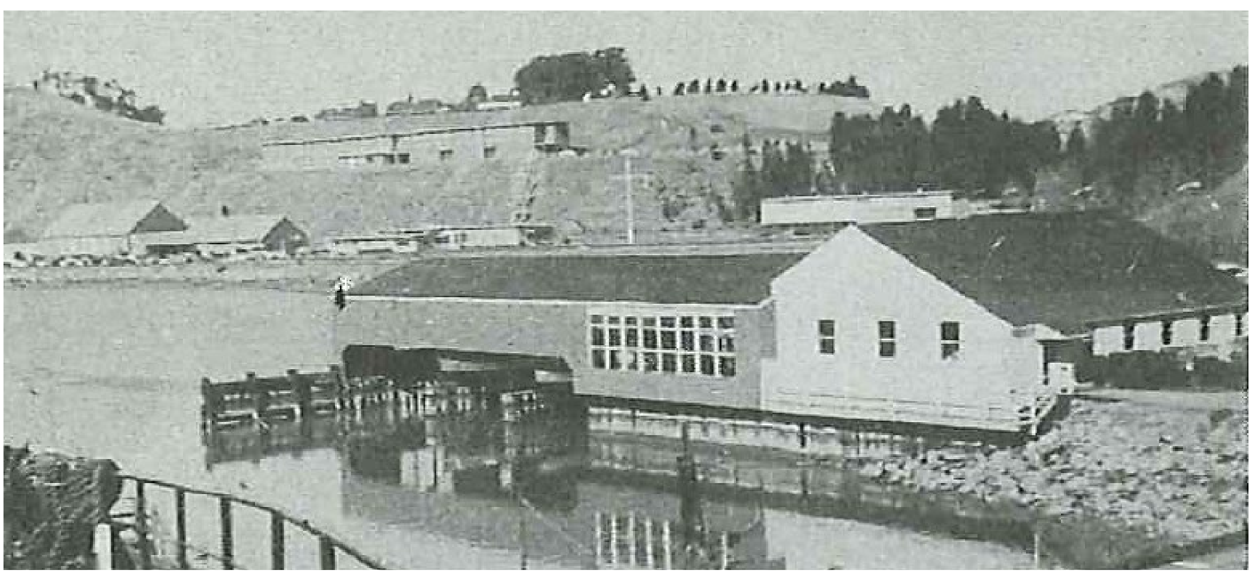


Figure 44: View of the Boathouse from the *Golden Bear*, 1959.
Source: *Hawsepipe*, 1959, Cal Maritime Campus History Collection.

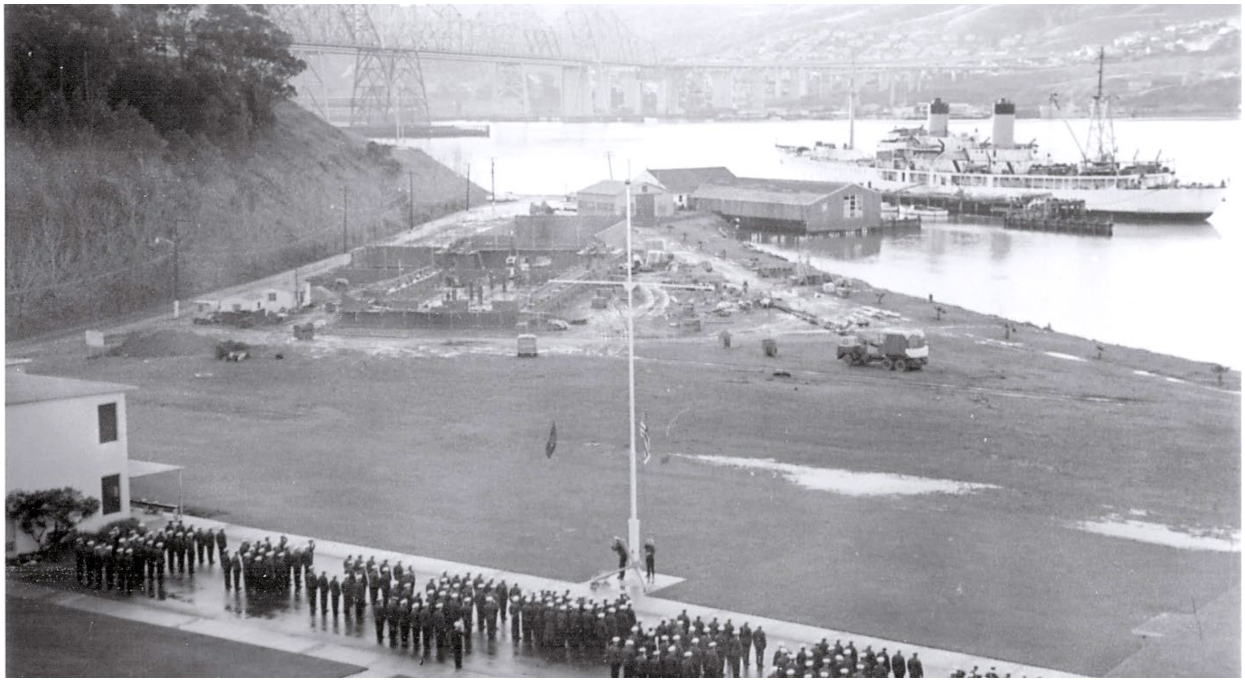


Figure 45: View of the campus looking south, c. 1959, with foundations underway for Dwyer Hall. East façade of Boathouse is visible in background. Source: Cal Maritime Campus History Collection.

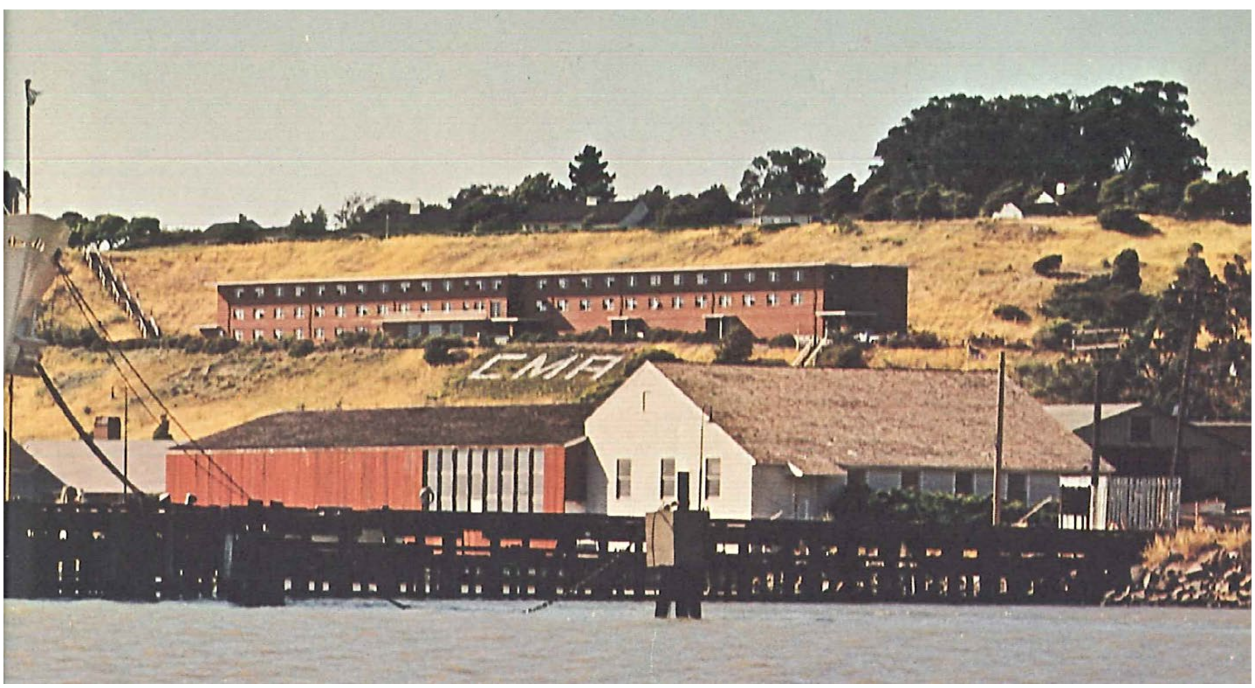


Figure 46: View of the campus with the Boathouse, c. 1968.
Source: *Hawsepipe*, 1968, Cal Maritime Campus History Collection.

Figure 47: West and south façades of the Boathouse,1960s. Source: Cal Maritime Campus History Collection.

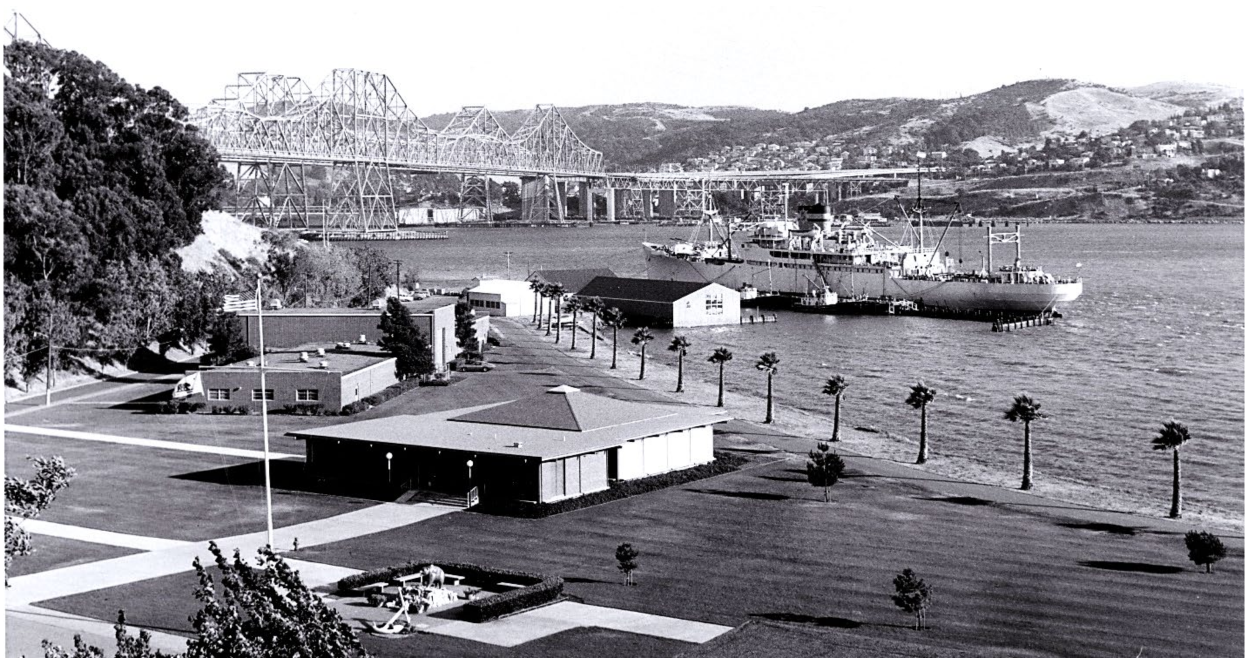


Figure 48: Boathouse in background, c. 1971. Source: Cal Maritime Campus History Collection.

Figure 49: West façade of the Boathouse, c. 1978.
Source: *Hawsepipe*, 1978, Cal Maritime Campus History Collection.

Appendix C – DPR Forms

The following appended DPR forms were prepared by Page & Turnbull in January 2022 and revised in January 2024. The information in these forms adapts the content of this report with the standardized DPR Form 523 A (Primary Record) and 523 B (Building, Structure, Object Record) format.

State of California — The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
PRIMARY RECORD

Primary #
HRI #
Trinomial
NRHP Status Code

Other Listings
Review Code Reviewer Date

Resource name(s) or number (assigned by recorder) Cal Maritime Boathouse

P1. Other Identifier:
***P2. Location:** ☐Not for Publication ☒Unrestricted ***a. County** Solano
***b. USGS 7.5' Quad** Benicia, CA **Date** 2018
***c. Address** 200 Maritime Academy Drive **City** Vallejo **Zip** 94590
d. UTM: (Give more than one for large and/or linear resources) Zone ______ mE/ ______ mN
***e. Other Locational Data:** Assessor's Parcel Number 0062-090-030

***P3a. Description:** (Describe resource and its major elements. Include design, materials, condition, alterations, size, setting, and boundaries.)
The Cal Maritime Boathouse was completed in 1946 and was designed in a utilitarian style by the California Department of Public Works, Division of Architecture, as one of the first permanent buildings of the new California Maritime Academy campus. The Boathouse is located along Morrow Cove near the Carquinez Strait at the south end of the Cal Maritime campus **(Figure 1)**. Historically, the building was also called the Seamanship Building. In 1989, the building was dedicated in honor of Edwin C. Miller, a past graduate of and teacher at the Maritime Academy and was renamed the Edwin C. Miller Seamanship Center.

The Boathouse has been in use as an educational building since its construction. It serves the Cal Maritime campus by storing the school's smaller boats; providing a location for maintenance and storage of small watercraft, sails, rigging, and tools; and includes small offices for staff and a workshop. The Boathouse also has a close connection to the waterfront and the adjacent wharf where Cal Maritime's Training Ship (currently the *T.S. Golden Bear III*) is regularly docked.

The building is not aligned to the cardinal directions, but for the ease and clarity of the building description, the façade that faces the bay and the wharf will be described as the west façade, the façade with the primary entrance will be described as the south façade, and so on. (Refer to Continuation Sheet, page 2.)

***P3b. Resource Attributes:** HP15. Educational building; HP39. Other
***P4. Resources Present:** ☒Building ☐Structure ☐Object ☐Site ☐District ☐Element of District ☐Other

P5a. Photo

P5b. Photo: (view and date)
Boathouse viewed from adjacent pier, looking northeast, September 18, 2021.

***P6. Date Constructed/Age and Sources:** ☒Historic ☐Prehistoric ☐Both
1945-46. Original drawings, December 1945.

***P7. Owner and Address:**
California State University Maritime Academy
200 Maritime Academy Drive
Vallejo, CA 94590

***P8. Recorded by:**
Barrett Reiter, Maggie Nicholson
Page & Turnbull, Inc.
170 Maiden Lane, 5th Floor
San Francisco, CA 94108

***P9. Date Recorded:**
January 5, 2022

***P10. Survey Type:** Intensive

***P11. Report Citation:** None

***Attachments:** ☐None ☐Location Map ☐Sketch Map ☒Continuation Sheet ☒Building, Structure, and Object Record ☐Archaeological Record ☐District Record ☐Linear Feature Record ☐Milling Station Record ☐Rock Art Record ☐Artifact Record ☐Photograph Record ☐ Other (list)

***P3a. Description (Continued)**

Figure 1: Boathouse at the Cal Maritime Academy campus. Building identified with dashed red line. Source: Google Maps, 2021. Edited by Page & Turnbull.

The Boathouse is L-shaped in plan, with the primary entrance located along the south end of the building which sits on land, while the north end of the building projects over the water of Morrow Cove to allow for boat slips along the north end of the west façade. The building's foundation consists of wood piles on concrete footings; it is clad in a combination of painted wood shingles and painted vertical wood siding and has an asphalt shingle-clad cross-gable roof. The overall style of the building is utilitarian with decorative elements limited to the cross-brace pattern applied to the building's original wood doors.

The base of the building's L-shaped plan contains the primary entrance and "sail loft," where historically sails were cut, sewn, and repaired, beneath a steeply pitched side-gable roof. This section of the building is clad in painted wood shingles. The remaining length of the building, which will be referred to as the transverse wing, is clad in vertical painted wood siding and has a lower pitched roof. This area contains a work platform, boat slips, and some areas for storage and tooling.

Primary (South) Façade
The south façade contains the main entrance to the building and faces a small paved parking area located immediately north of the dock. The original entrance door consists of a painted wood door with an applied cross brace pattern. It is located at the west (left) end of the south façade but is currently not in use and blocked with a bench at the exterior **(Figure 2 and Figure 3)**. A small shed roof extends from the primary roof form over this entrance and has a wood paneled soffit with a ceiling-mounted light. To the west (left) of the entrance door, a wood staircase with a wood railing descends to a small wood walkway and dock along the west façade that extends over the water.

The remaining openings of the south façade consist of a single one-over-one vinyl replacement window to the east (right) of the original entrance door, a single leaf wood door that is currently used as the primary entrance door, and three evenly spaced one-over-one vinyl replacement windows **(Figure 4)**. A decorative dedication plaque is mounted to the east (right) of the current primary entrance door that reads "Edward C. Miller Seamanship Building." A wood sign over the entrance reads "Boat House."

Figure 2: South façade of the Boathouse, looking northeast.

Figure 3: South façade of the Boathouse, looking northwest.

Figure 4: Detail of east portion of the south façade. Looking northeast.

East Façade
The east façade of the sail loft portion of the Boathouse has a louvered vent centered within its gable peak and openings at the ground floor consist of two non-original partially glazed wood doors and two non-original, double-hung, one-over-one vinyl windows **(Figure 5 and Figure 6)**.

The transverse wing of the Boathouse has a single-leaf wood door within a recessed opening near its south end, a wood utility door with an applied cross-brace pattern to the north of the door, and four evenly spaced non-original aluminum slider windows along the remaining length of the building **(Figure 7 and Figure 8)**.

Figure 5: Detail of doors at east façade of the sail loft portion of Boathouse, looking south.

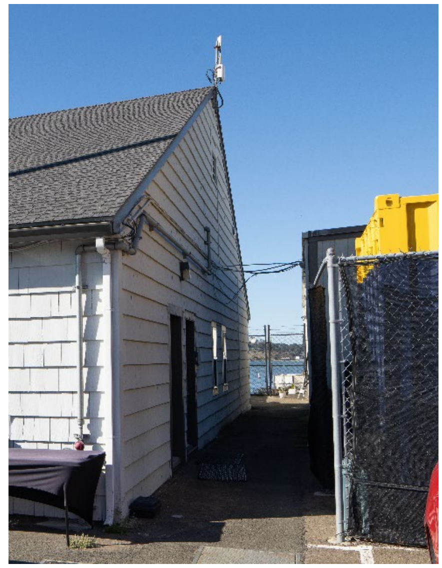


Figure 6: Oblique view of east façade of the sail loft portion of the Boathouse. Looking southwest.

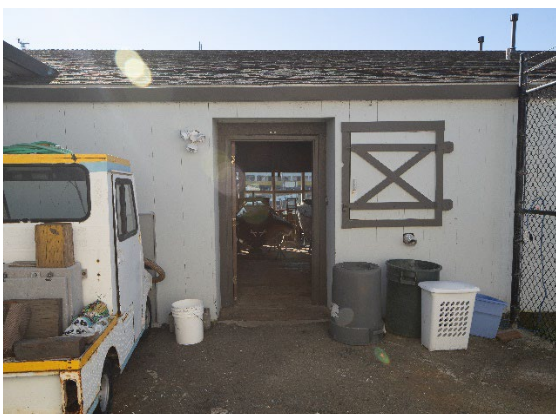


Figure 7: South end of the east façade of the transverse wing of the Boathouse, looking west.

Figure 8: East façade of the transverse wing of the Boathouse. Looking slightly southwest.

North Façade

The north-facing wall of the sail loft portion of the building has a single one-over-one vinyl replacement window **(Figure 9)**. The north façade of the transverse wing features a one-over-one vinyl replacement window at its east (left) side and a gridded window arrangement of fixed glazing that is three panels wide and four panels tall with painted wood mullions **(Figure 10)**.

***Recorded by** Page & Turnbull, Inc. ***Date** January 24, 2024 ☒ Continuation ☐ Update

Figure 9: North-facing wall of sail loft portion of Boathouse. Looking slightly southwest.

Figure 10: North façade of Boathouse, looking southwest.

West Façade

The west façade of the Boathouse along the transverse wing is open to the wharf and Morrow Cove for approximately half of its length to accommodate a number of boat slips **(Figure 11)**. The corners of this wide opening are clipped, and wood posts are visible that separate the boat slips and support the interior structure. The Cal Maritime logo and lettering reading “CAL MARITIME” is centered over this opening. To the south (right) of the opening for the boat slips is a large gridded window arrangement of eight windows wide and three windows tall with painted wood mullions.

The west façade of the sail loft of the Boathouse has a louvered vent centered within its gable peak and three evenly spaced one-over-one vinyl replacement windows **(Figure 12)**. A wall-mounted air conditioning unit is located near the south (right) corner of the west façade.

Figure 11: West façade of the Boathouse as seen from the Cal Maritime dock, looking east.

Figure 12: West façade of sail loft portion of the Boathouse. Looking slightly northeast.

Interior of Boathouse

As mentioned previously, the Boathouse consists of a sail loft, where historically sails were cut, sewn and repaired, and a transverse wing that contains the boat slips, work platform, and storage aisle **(Figure 13)**. The interior of the sail loft portion of the Boathouse has been divided into a number of small rooms including offices, workspaces, storage, and a kitchen **(Figure 14 to Figure 17)**. Some original wood doors with applied cross braces are extant, including the door between the sail loft and the work platform and the door to the kitchen **(Figure 16 and Figure 17)**. Floors consist primarily of wood, but some areas within the sail loft portion of the building have applied linoleum tiles, including the kitchen, entrance lobby, some offices, and the bathroom. Lighting throughout the building consists of non-original, ceiling-mounted, fluorescent lighting. The kitchen and some offices along the midpoint of the building have drop ceilings.

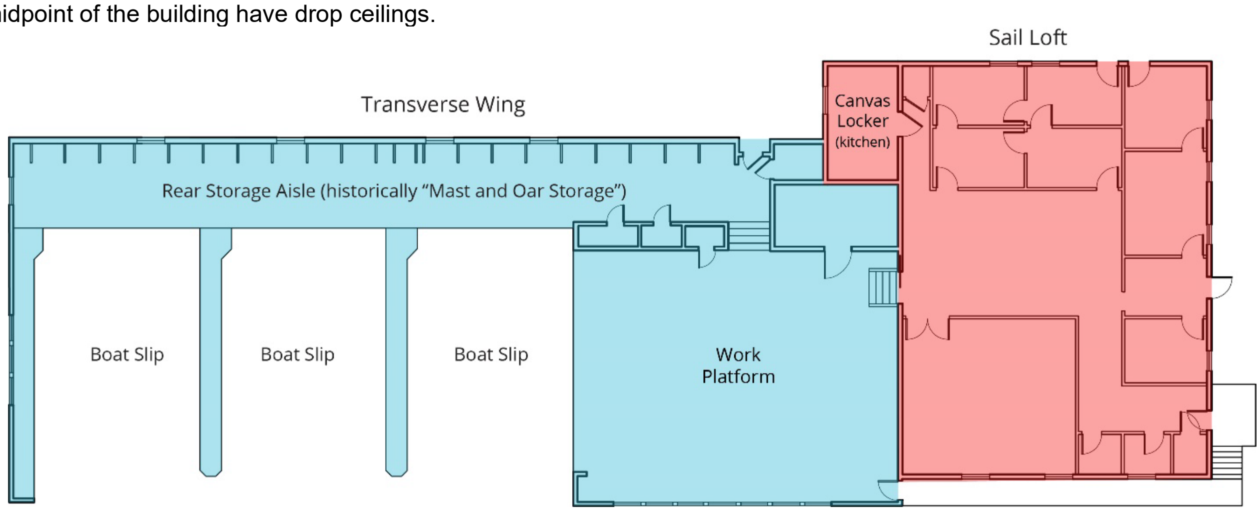


Figure 13: Floor plan of Boathouse, with transverse wing shaded blue and the sail loft including the canvas locker (now the kitchen) shaded red. Source: Page & Turnbull, based on original 1945 floorplan and measurements of existing partitions.

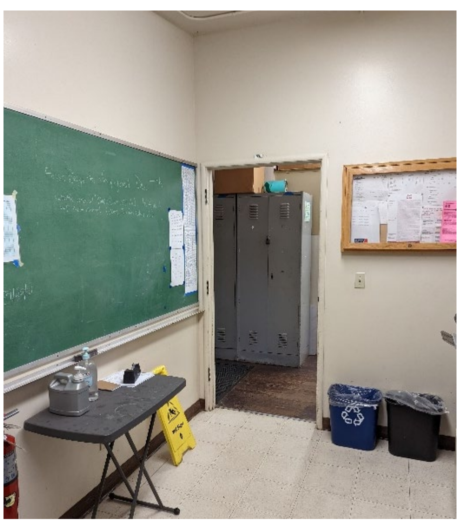


Figure 14: Looking slightly northwest from within the sail loft portion of the Boathouse.

Figure 15: Original door extant in sail loft portion of Boathouse.

Figure 16: Looking slightly northwest from within the sail loft portion of the Boathouse.

Figure 17: Original door extant in sail loft portion of Boathouse.

The transverse wing is divided into three areas including the boat slips, which fill the majority of the north end of the wing and are open to the exterior; a work platform that is positioned behind the windows of the west façade and connects to the sail loft with a small flight of wood steps and an original wood door with applied cross bracing; and an elevated aisle along the east wall of the wing that is labeled as mast and oar storage on the original plans and used for general storage of rope, lifejackets, masts, oars, and other related material **(Figure 18, Figure 19, and Figure 20)**.

Figure 18: Looking north at the boat slips from the work platform. Note the yellow painted metal ladders from the rear storage area.

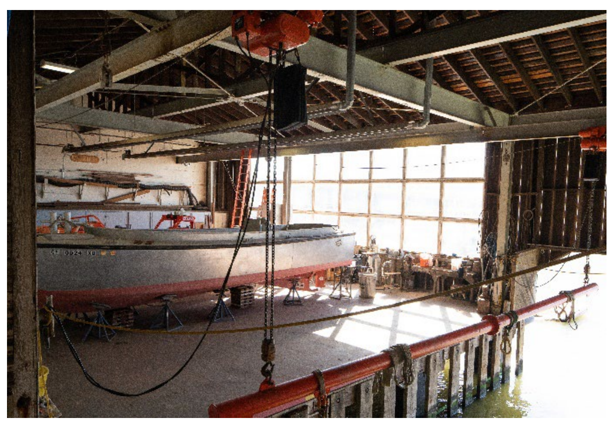


Figure 19: The work platform, as viewed from the elevated rear storage area, overlooking the south end of the boat slips. Looking southwest.

Figure 20: Looking south into the sail loft from the work platform.

Figure 21: Looking northeast from the work platform to the elevated storage area.

This elevated aisle is reached by wood stairs from the work platform and overlooks the boat slips **(Figure 21)**. A wood railing separates the elevated storage area from the boat slips, and small metal ladders along its west side provide access to the boat slips **(Figure 22)**. An enclosed section at the south end of the rear storage area houses a restroom and storage areas **(Figure 23)**. A notable feature of the transverse wing of the Boathouse is the exposed steel frame that supports the wood framed roof and connects to the foundation piers at key locations **(Figure 24)**.

Figure 22: Looking north along the elevated rear storage area.

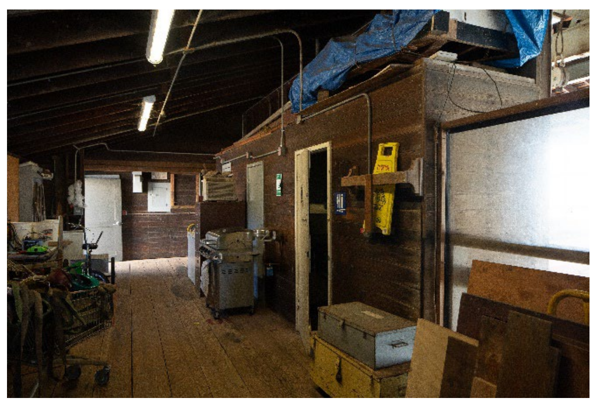


Figure 23: Looking south along the elevated rear storage area.

Figure 24: Looking southwest and up at metal framing of building.

Related Site Features
The Boathouse is located at the southern end of the Cal Maritime campus, and it is closely associated with the pier that has been present at this location since the early 1940s. The existing pier was constructed in 1995-1997, replacing a 1940s wood wharf, and features a concrete deck with timber piers, a steel frame structure, and a steel sheet pile breakwater.[1]

A number of temporary buildings, sheds, and utility structures have been erected in the area of the Boathouse since its construction in 1946 **(Figure 25)**. This area, including the parking lot at the southeast end of the Boathouse, is currently blocked off with a metal fence and security station.

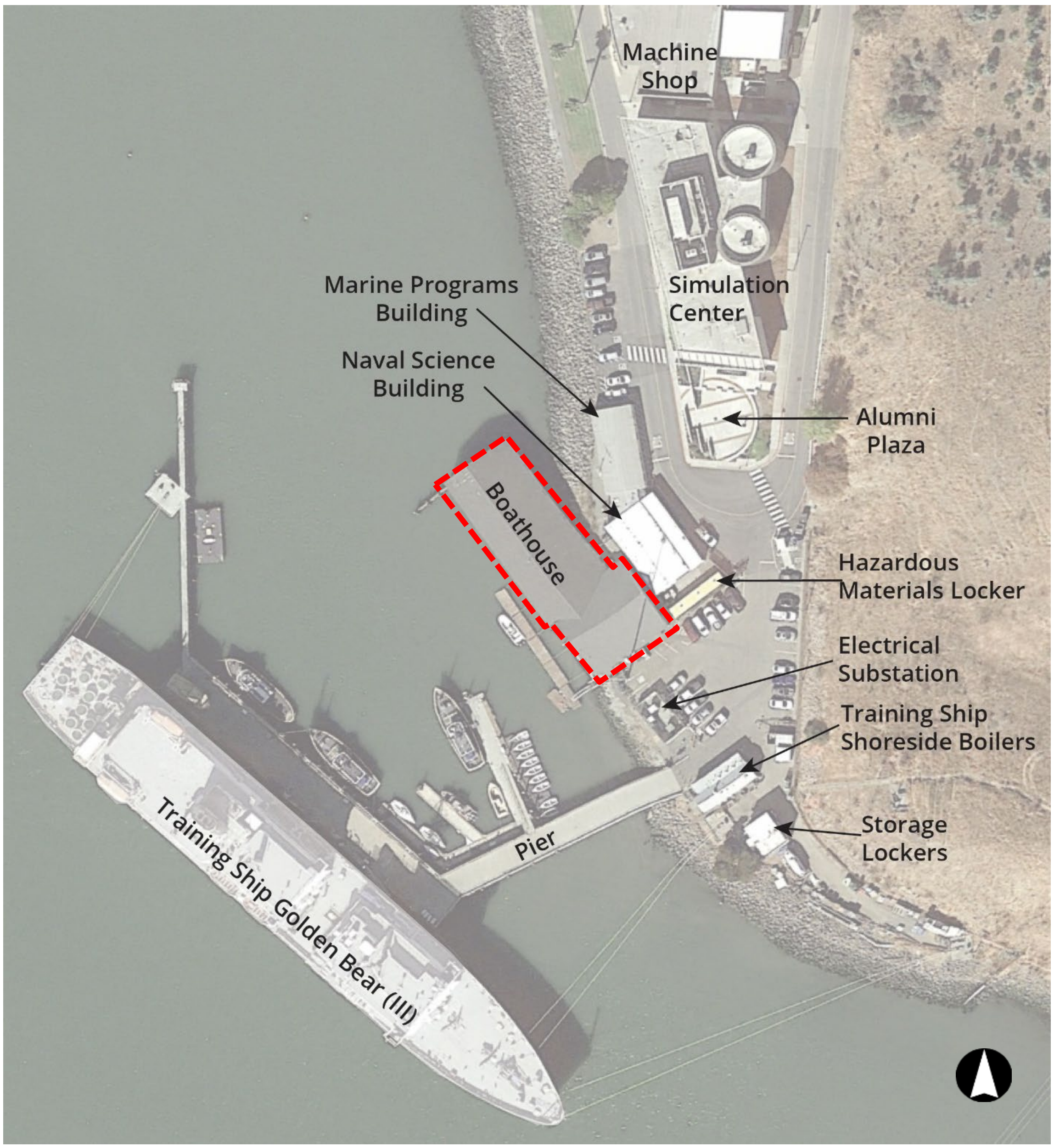


Figure 25: Buildings and structures located around the Boathouse (outlined with dashed red line). Source: Page & Turnbull. Base map: Google Earth aerial photograph, 2021.

[1] Refer to "California Maritime Academy: Pier Extension" drawings, dated June 28, 1995.

BUILDING, STRUCTURE, AND OBJECT RECORD

***NRHP Status Code** 3S, 3CS

***Resource Name or #** Cal Maritime Boathouse

B1. Historic name:

B2. Common name: Cal Maritime Boathouse

B3. Original Use: Educational/Maritime

B4. Present use: Educational/Maritime

***B5. Architectural Style:** Utilitarian

***B6. Construction History:** (Construction date, alterations, and date of alterations)

Development of Morrow Cove as the Cal Maritime Campus

Morrow Cove was one of the many sites that was visited during the search for a new campus for the California Maritime Academy in the early 1940s. In December 1940, a survey party of administrators from Cal Maritime visited Morrow Cove, which had some piers, structures, and the remnants of the *Bangor* sailing schooner and the *Contra Costa* ferryboat **(Figure 18)**. (Continued on page 11.)

***B7. Moved?** ☒No ☐Yes ☐Unknown **Date:** **Original Location:**

***B8. Related Features:** None

B9a. Architect: California Department of Public Works, Division of Architecture b. Builder: unknown

***B10. Significance: Theme** Establishment of Cal Maritime Campus **Area** Vallejo

Period of Significance 1946 **Property Type** Boathouse **Applicable Criteria** A/1 (Events)

Historic Context:

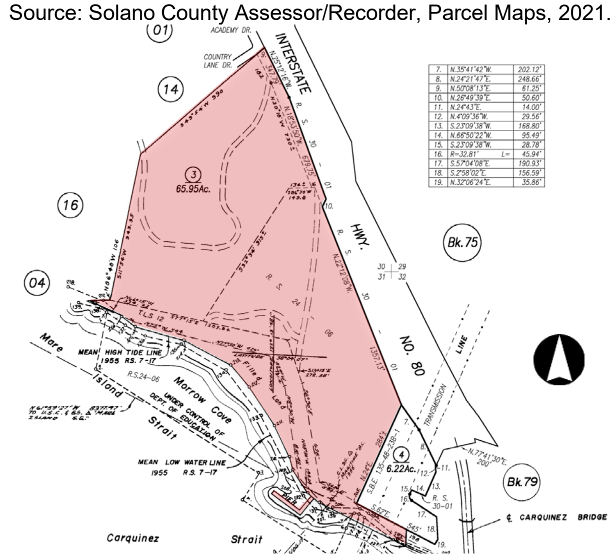
Brief History of Morrow Cove Prior to 1940

Located at the mouth of the Carquinez Straight, Morrow Cove is now the southernmost tip of Vallejo, but until the construction of the Carquinez Bridge in 1927 this area remained remote from the growing city of Vallejo.

The following brief history of Morrow Cove is summarized from several sources including *A Brief History: The California Maritime Academy Historical Archives* written by archivist Doug Peterson for the 75th anniversary of the school, the Historic American Engineering Record (HAER) report on the Carquinez Bridge, historical newspaper articles, and various articles on the history of the campus that were included in *Hawsepipe,* the yearbook of Cal Maritime.[2]

Prior to the construction of the Carquinez Bridge in 1927, several ferries and automobile ferries operated along the Strait in order to allow navigation from Vallejo to the East Bay. Early automobile ferries that operated along the Strait include the Martinez-Benicia Ferry & Transportation Company in 1913, the Rodeo-Vallejo Ferry Company in 1918, and the Six-Minute Ferry in 1919, which operated between Morrow Cove and the town of Crockett.[3] Unfortunately, the Six-Minute Ferry's terminal at Morrow Cove was destroyed by a landslide in 1922. The Rodeo-Vallejo Ferry Company acquired the holdings of the Six-Minute Ferry and expanded its ferry business, which transported over one million passengers annually in approximately 400,000 vehicles in 1923 and 1924 **(Figure 16)**.[4] (Continued on page 12.)

Source: Solano County Assessor/Recorder, Parcel Maps, 2021.



B11. Additional Resource Attributes: N/A

***B12. References:** See footnotes and bibliography, page 19.

B13. Remarks: N/A

***B14. Evaluator:** Barrett Reiter and Maggie Nicholson, Page & Turnbull, Inc.

***Date of Evaluation:** January 5, 2022, revised January 24, 2024

(This space reserved for official comments.)

[2] Doug Peterson, *A Brief History: The California Maritime Academy Historical Archives,* CSU Maritime (website), Accessed September 21, 2021, https://www.csum.edu/about/media/cal-maritime-history-75th-anniversary.pdf; National Park Service, *Carquinez Bridge,* Historic American Engineering Record (HAER No. CA-297).

[3] George H. Harlan, *San Francisco Bay Ferryboats,* (Berkeley: Howell-North Books, 1967), 17.

[4] Charles Derleth. "Cantilever Highway Bridge Across Carquinez Strait." *Engineering News-Record*, September 24,1925, 504.

***B6. Construction History (continued):**

Development of Morrow Cove as the Cal Maritime Campus (continued)

As early as 1941, the 67-acre area along the shore of Morrow Cove was approved as the location of the new California Maritime Academy campus; but acquiring funding and navigating the political situation during World War II delayed the school's occupation of the site.[5] While piles were driven for a new pier as early as 1941, the site was not suitably completed for occupation by the school until August 1943 **(Figure 29)**. At this time, the Training Ship (T.S.) Golden State was able to dock at the new wharf, and several temporary buildings provided facilities for students and teachers.[6] The site was developed in earnest in 1943 while the land was cleared, leveled, and graded and 330,000 cubic yards of earth were relocated from higher on the site to fill in a portion of the Cove.[7] At this time, the remnants of the hull of the *Bangor* were buried in the area that was infilled. Attempts to remove the hull of the *Contra Costa*, including refloating, towing, dredging, and dynamiting, all failed and elements of the hull remain extant and can be seen at low tide.[8] This process of infill extended the shoreline westward into the bay and created 12 additional acres of flat land along the shore.[9] Permanent structures were then added through phased construction.

The construction program to erect permanent buildings on the campus was announced in early 1944 and started in September 1945 with the laying of a cornerstone for the gymnasium (now called Mayo Hall).[10] This permanent building plan followed the guidance of a Master Development Plan developed by the California Department of Public Works, Division of Architecture, that proposed a symmetrical arrangement of buildings and pavilions that flanked a central Drill Field located along the shoreline **(Figure 30)**. The Master Plan showed a "Boat Shed" at the location of – and with a similar footprint to – the sail loft portion of the existing Boathouse; a separate Sail Loft building was proposed to be located north of the Boat Shed. The Master Development Plan appears to have helped guide the placement of some of the early facilities of the campus. However, the Boathouse – as it was constructed with its L-shaped footprint – did not adhere to the Master Development Plan. It was designed in 1945 and completed in 1946.[11]

When completed, the Boathouse was used for "instruction in manila and wire splicing, canvas work, boat overhaul, and the reeving of blocks and tackles."[12] The campus remained relatively open along its southern end until the erection of Dwyer Hall, which was completed in 1960 and was the first large campus building located near the Boathouse **(Figure 31)**. Since that time, a number of new buildings have been erected at the campus, including the replacement of Dwyer Hall. Today, two modular buildings have been erected just east of the Boathouse – for Marine Programs and Naval Science – and the Simulation Center and the Steam Plant Simulator are located just north of that.[13]

Construction of the Boathouse

Due to the ownership of the campus by the California State University system, building permits are not on file with the City of Vallejo. Beyond the original drawings of the Boathouse, the staff at Cal Maritime was unable to locate permits or drawings in their records that depicted alterations.

The Boathouse, as it appears today, is largely unaltered from its original form and design at the exterior as illustrated by the 1945 drawings by the Department of Public Works, Division of Architecture and from mid- and late 1940s photographs **(Figure 32, Figure 33, and Figure 34)**. Along the interior, alterations have been made primarily to the south end of the building within the area historically called the sail loft. Alterations to the exterior and the interior are listed below.

The following list of exterior alterations have occurred since the Boathouse was completed in 1946; alterations have been established through visual comparison between the original drawings from 1945, available historic photographs, and the Boathouse today.

- Reroofed at an unknown date, replacing the original wood-shingle roof
- Doors and windows installed along east façade of the sail loft portion of building after 1971 **(Figure 35)**

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[5] Confusion around the federal agencies involved in the administration of the Merchant Marine was one of the factors that caused additional delay as Cal Maritime's campus project was placed under the jurisdiction of the Coast Guard and then subsequently reverted to the War Shipping Administration through an executive order by President Roosevelt. "Work Ordered on Maritime School at Morrow Cove," *Long Beach Sun,* July 10, 1942.
[6] The last temporary building from the early 1940s was removed in 1979. Refer to "1940s,"*Hawsepipe,* 1993, 51.
[7] "Sea Academy Contract is Let, *The Sacramento Bee,* November 4, 1943. This contract was let to A. Teichert & Company of Sacramento.; For number of yards of earth moved refer to: "The Interim Years: 1940-1943," *Hawsepipe,* 1963, 254.
[8] Peterson, unpublished manuscript on file at the Campus History Center.
[9] "The Interim Years: 1940-1943," *Hawsepipe,* 1963, 254.
[10] "Maritime Academy Expansion Planned," *Oakland Tribune,* February 15, 1944, 11.; "California Maritime Academy," *Pacific Marine Review,* October 1945, 579.
[11] Refer to 1945 drawings of the Boathouse and Wharf. Supplied to the author by the administration of CSU Maritime.
[12] Committee on Efficiency and Cost Control, *The California Maritime Academy: Report of the Committee on Efficiency and Cost Control*, April 26, 1971, 4.
[13] LSA, *California State Maritime Academy, Physical Master Plan, Final Environmental Impact Report,* May 2018. Existing Facilities, Figure 3-3.

- Door installed at primary (south) façade between 1976 and 1989 **(Figure 36 and Figure 37)**
- Small aluminum slider windows installed at east façade of transverse wing at an unknown date[14]
- Edwin C. Miller dedication plaque installed circa 1989[15]
- Original one-over-one double-hung wood windows replaced with vinyl windows at all locations since 2008 **(Figure 38)**
- Fixed glazing of large window arrangements at west and north façades replaced in kind at an unknown date

The following list of interior alterations relates primarily to the sail loft portion of the Boathouse. All alterations were identified through visual observation of the existing conditions of the Boathouse's interior and a comparison with the original 1945 drawings of the building.

- Erection of several interior partitions within the sail loft for offices, an entrance vestibule, machine shop, storage areas, and restroom
- Installation of linoleum flooring in some offices
- Installation of drop ceilings in some offices along the east of the sail loft
- Installation of ceiling-mounted fluorescent lighting

Overall, the Boathouse remains largely unaltered in its original materials, form, use, and location.

***B10. Significance:**
Historic Context (continued)
Brief History of Morrow Cove Prior to 1940 (continued)
The automobile ferry business was highly successful, but many drivers still chose to take the land route, consisting of an additional 30 miles, to avoid waiting for the ferry which struggled to meet the demand. Therefore, the owners of the Rodeo-Vallejo Ferry Company began to plan for the construction of a toll bridge to cross the Carquinez Strait and formed the American Toll Bridge Company. When the Carquinez Bridge opened in 1927, with its two main spans of 1,100 feet each, it had the second longest cantilever spans in the country and the fourth longest in the world.[16] In addition to its status as an engineering marvel, when completed, the Carquinez Bridge shortened the route from Sacramento to the Bay Area and was integrated into the transcontinental Lincoln Highway.

In the late 1920s, it appears that Morrow Cove had already become popular as a local fishing spot for bass, which feed in the area. By the early 1930s, the American Toll Bridge Company (who developed the Carquinez Bridge) sought to expand the appeal of the area and create a popular recreation area that would serve the citizens of Vallejo, the residents of the larger Bay Area who could now easily reach Morrow Cove for a day of leisure, and the tourists moving along the Lincoln Highway route. In 1933, the American Toll Bridge Company undertook a number of improvements including landscaping the Cove and installing a dance platform, playgrounds, picnic areas, and bathing facilities **(Figure 27)**.[17] Fishing clubs sprung up along the shoreline, and the cove even had a small café to provide refreshments. Enhancing the swimming area was a significant man-made breakwater, in the form of two abandoned ships: the *Bangor,* a sailing schooner, and the *Contra Costa,* a ferryboat that transported railcars.[18]

At the beginning of U.S. involvement in World War II in December 1941, the California Department of Public Works issued an order to restrict access to Morrow Cove due to its proximity to the base of the Carquinez Bridge, which was seen as a strategic link between the "lower bay region and the Vallejo-Mare Island defense area."[19] This protective measure against possible sabotage of the bridge closed Morrow Cove to swimmers and fishermen in the 1940s. It is likely that public access to Morrow Cove remained restricted throughout World War II and allowed for this area to be considered as a possible location for the future Cal Maritime campus.

History of Cal Maritime
The following brief history of the early establishment of Cal Maritime, originally called the California Nautical School, has been excerpted from the 1979 volume of *Hawsepipe,* on the 50th Anniversary of the school.[20]

[14] A c. 1960s photograph in the collection of the CSU Maritime Campus History Collection offers a rare view of this rear façade and shows that no windows were present at that date. Refer to **Supplementary Materials** (beginning at page 19).
[15] Refer to *Hawsepipe*, 1989 or *Pacific Northwest News*, November 2009. Both sources describe the dedication of the Boathouse to Edwin C. Miller.
[16] National Park Service, *Carquinez Bridge,* HAER No. CA-297, 22.
[17] "Morrow Cove Playground," *Oakland Tribune,* August 13, 1933, 10.; "New Bathing Beach Open on Carquinez Straits Today," *The San Francisco Examiner,* May 7, 1933.; "Morrow Cove Beach Opens Next Sunday," *Oakland Tribune,* April 30, 1933.
[18] Doug Peterson, unpublished manuscript on file at the Campus History Center.
[19] "State Acts to Ban Residents In Morrow Cove," *The Sacramento Bee,* December 9, 1941.
[20] *Hawsepipe,* 1979, 6-12.

> California Maritime Academy was established [in 1929] by an Act signed into law by California Governor Young. This legislation was called the California Nautical School Act of 1929 and made possible the formation of a state owned school to train Engineering and Deck officers of the U.S. Merchant Marine. In 1931, after two years of preparations, the first group of midshipmen were enrolled at the California Nautical School's temporary campus at the U.S. Navy Coaling Station near Tiburon [in Marin County]. [….]
>
> But the fledgling California Nautical School soon faced serious financial and political problems and was in danger of being shut down. This period of uncertainty and hardship for the school started in 1933 and lasted for about six years. There were several attempts to close the California Nautical School due to an ailing national economy and an apparent drain on desperately needed government resources. Only through the efforts of many dedicated supporters were these attempts successfully circumvented and minimal funding was continued by the state.
>
> When news came in 1939 of a possible war with Germany, the Navy needed the Tiburon coaling station and the California Nautical School had to look for another location. After more than a year of searching and after the consideration of many sites for a campus, the Board of Governors of the school decided on Morrow Cove in Vallejo. The people of Vallejo were very much in favor of the proposition and gave the school some greatly needed support. During the interim, however, the school was first moved to Pier 54 in San Francisco, and then to the Ferry Building on Pier 2 a year later.
>
> The future of the California Nautical School began to look much better with the growing demand for Merchant seamen in the early 1940's. It was during this period, […] that the California Nautical School was renamed the California Maritime Academy.[21] However, there were many delays and problems in trying to secure the expected $2.5 million estimated to develop the Morrow Cove site. In fact, after Pearl Harbor was attacked, the plans for construction of the new campus were almost completely dropped. In 1942, the Wartime Shipping Administration took over the Academy and through this agency, the original construction plans for Morrow Cove were revived.

Although the school was displaced from its Tiburon campus due to World War II, the California Maritime Academy continued to serve a critical role in the training and supplying of officers during the war. The educational program, which had introduced a three-year program for students to qualify for a merchant marine officer's license, was shortened to 18 months to supply trained officers more quickly.[22] Eleven graduates lost their lives in the line of duty during the war and were remembered at a dedication ceremony for Mayo Hall in 1946.[23] Immediately after World War II, the three-year program was restored, and the traditional training cruises were resumed. The school's annual training cruises, which provide students with hands-on experience navigating, piloting, maintaining, and running a ship, are held on the Cal Maritime Training Ship (T.S.), currently the T.S. Golden Bear III, which is on long-term loan from the United States Maritime Administration. The Academy has had four training ships: T.S. Golden State (1931–1946), T.S. Golden Bear I (1946–1971), T.S. Golden Bear II (1971–1995), and T.S. Golden Bear III (1996–present).[24] When not involved in the various cruises, the training ship is docked at the wharf adjacent to the Boathouse and provides additional educational facilities.

Despite the Academy's role in helping supply a trained Merchant Marine both during and outside of the war effort, the California Maritime Academy and the other state-run maritime academies were under threat of budget cuts and closures in the 1950s and in the 1970s. This was partially due to their complicated financial position where funding was supplied both from the federal government and each respective state legislature. In 1954, discussions on the need to crew the United States' vastly enlarged naval fleet strongly supported the ongoing funding of these institutions by the federal and state legislatures. In both instances, the value of these maritime academies was seen as essential to meeting the personnel needs of the merchant marine, the Coast Guard, and the Naval Reserve, in addition to staffing allied shipping industries – all industries that support the long-term maritime defense capabilities of the nation.[25]

Other notable milestones in Cal Maritime's history include the acceptance of women to the school in 1973, the establishment of a four-year college degree in the mid-1970s, and the full academic accreditation of the school in 1977.[26] In 1995, the California Maritime Academy became the 22nd campus of The California State University (CSU) system, officially becoming California State University Maritime Academy.[27]

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[21] The adoption of the name California Maritime Academy occurred in 1939. This excerpt from *Hawsepipe* mistakenly lists the date as 1940, which appears to be incorrect based on other sources. It has therefore been omitted in this instance.
[22] "State Maritime Academy Marks 25th Anniversary," *Sacramento Bee,* September 9, 1954, F1.
[23] Peterson, *A Brief History: The California Maritime Academy Historical Archives,* 8.
[24] Cal Maritime, "History of the Training Ship Golden Bear," *Cal Maritime* (website), Accessed November 30, 2021, https://www.csum.edu/about/tsgb/history.html
[25] "California's Academy," *Maritime Reporter,* October 1, 1952, 16.
[26] *Hawsepipe*, 1979, 19.
[27] Peterson, *A Brief History: The California Maritime Academy Historical Archives,* 13.

Brief Biography of Edwin C. Miller

The Boathouse was renamed and dedicated in 1989 in honor of Edwin C. Miller, a 1934 graduate of the California Nautical School (prior to the time it became known as Cal Maritime).

Miller enrolled at the California Nautical School in 1931 and graduated in 1934.[28] He briefly returned to the school to teach in 1935, after working as a Third Mate for the Grace Lines fleet. He appears to have remained actively involved with Cal Maritime into the early 1940s, despite a career with the U.S. Navy, and he was one of the members of the survey party that visited Morrow Cove in 1940 while looking for a new campus location.

During World War II, as part of his position in the Navy, Miller was assigned to teach seamanship and navigation to cadets at Cal Maritime. In 1945, Miller left his teaching post at the school to return to a full-time position with the Navy and did not retire until 1960. At that time, Miller returned to Cal Maritime to teach for the next nine years, retiring in 1969. In 1971, Miller briefly returned to Cal Maritime to serve as Interim President and was notably the first graduate of the school to then serve as its President.

Miller was well-regarded by the staff and students of Cal Maritime. He continued to be involved in the school through its Alumni Association (of which he was a charter member). In 1989, his many contributions to the school were recognized with the dedication and renaming of the Boathouse in his honor. Edwin C. Miller passed away in 1993.

Statement of Significance:

In order for a property to be considered eligible for the National Register of Historic Places (National Register) and/or the California Register of Historical Resources (California Register), the property must possess significance and retain integrity to convey that significance. The criteria for significance are:

Criterion A/1 (Events): Associated with events that have made a significant contribution to the broad patterns of local or regional history or the cultural heritage of California or the United States.

The Boathouse at Cal Maritime was constructed from 1945-1946 and was one of the earliest permanent structures to be completed at Cal Maritime's new campus at Morrow Cove. Other structures that had already been completed by this time include the original wharf (since replaced) and Mayo Hall (completed 1945). The Boathouse, in its use and its location along the waterfront, is closely associated with the establishment of the new campus. The creation of a purpose-built campus in the 1940s was a significant investment in the establishment of the California Maritime Academy that illustrated the important role that the school had played during World War II and recognized the importance of retaining and supporting the only degree-granting maritime academy on the West Coast. The Boathouse was an important investment in the teaching facilities of the campus and, like Mayo Hall, was critical to the development of the permanent campus.[29] Additionally, the Boathouse is a unique element of the campus that is closely associated with the maritime nature of the Academy itself, and unlike the other buildings of the campus, provides a close connection to the water through its placement and its use. The Boathouse serves a key function as the location where small watercraft are stored, maintained, and repaired. It stores the necessary equipment to support the maritime activities of the students, including life jackets, oars, and sails, and supports the outfitting and running of the Training Ship. Therefore, the Boathouse appears to be eligible for the National Register and the California Register under Criterion A/1, with a period of significance that dates to 1946 and corresponds to the completion of the building.

Criterion B/2 (Persons): Associated with the lives of persons important to local, California or national history.

The Cal Maritime Boathouse is not particularly associated with any individual person such that it would be individually eligible for the National Register or the California Register under Criterion B/2. The building has been owned and operated by the Cal Maritime since its construction and has been associated with many teachers and students since the 1940s. The building was dedicated to Edwin C. Miller in 1989 to recognize his many contributions to the school, which included his many years of teaching and a period as the Interim President of Cal Maritime. While the Boathouse was dedicated in his honor, the available material on Miller's career is not clearly associated with the Boathouse and it is not known whether he was particularly involved with the use of the Boathouse during his time as a teacher at Cal Maritime. As such, the Boathouse does not appear to be eligible for the National Register nor the California Register under Criterion B/2 for its association with any individuals.

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[28] This brief biography of Edwin C. Miller is largely based on the material included in "Did You Know…?" *Pacific Northwest News*, November 2009. A copy of this publication was provided to the author by the staff of the CSU Maritime Campus History Collection.

[29] In 2018, Mayo Hall was found significant under Criteria 1 and 3. This preliminary finding was then confirmed with the preparation of DPR forms in 2020, when a rehabilitation project for Mayo Hall was undertaken that included California Public Resources Code (PRC) Section 5024 and 5024.5 consultation with the California Office of Historic Preservation (OHP). The significance evaluation of Mayo Hall under Criterion 1 stated that "the building remains a visible and prominent remnant of the early formation of the California Maritime Academy and was crucial to the school's early development." The finding of the Boathouse as significant under Criterion 1 is consistent with the previous finding for Mayo Hall.

Criterion C/3 (Architecture): Embodies the distinctive characteristics of a type, period, region or method of construction or represents the work of a master or possesses high artistic values.

The Boathouse was designed in 1945 by the California Department of Public Works, Division of Architecture, and was completed in 1946. The building is relatively simple in its design as a utilitarian Boathouse that serves the Cal Maritime waterfront. The building has undergone some alterations to its exterior and interior, but remains largely intact in regard to its materials, form, and massing. Along the exterior, alterations include the replacement of the roof, the replacement of all original double-hung wood windows with double-hung vinyl sash, the alteration to openings along the east façade where three windows were replaced with two doors and two windows, the installation of small aluminum slider windows along the east façade of the transverse wing, and the removal of an original window opening at the south façade to install a new entrance door. In areas where windows were replaced, the original openings have been retained and the replacement windows have matched the original design of a one-over-one double-hung window. At the interior, the sail loft portion of the Boathouse has been altered from its original form as a single open space with the erection of some partitions. Drop ceilings and linoleum flooring have been installed at some locations within the sail loft. Despite the Boathouse's retention of integrity (refer to the following section for analysis), it does not appear to be individually significant for its architecture as it is not a high-style example of a boathouse, nor was it designed by a master architect. Therefore, the Boathouse does not appear eligible for the National Register nor the California Register under Criterion C/3.

Criterion D/4 (Information Potential): Has yielded, or has the potential to yield, information important to the prehistory or history of the local area, California or the nation.

The "potential to yield information important to the prehistory or history of California" typically relates to archeological resources, rather than built resources. When National Register and California Register Criterion D/4 (Information Potential) does relate to built resources, it is relevant for cases when the building itself is the principal source of important construction-related information. The analysis of the property at the Boathouse for eligibility under Criterion D/4 is beyond the scope of this report.

Integrity

In order to qualify for listing in any local, state, or national historic register, a property or landscape must possess significance under at least one evaluative criterion as described above and retain integrity. Integrity is defined by the California Office of Historic Preservation as "the authenticity of an historical resource's physical identity evidenced by the survival of characteristics that existed during the resource's period of significance," or more simply defined by the National Park Service as "the ability of a property to convey its significance."[30]

Page & Turnbull used established integrity standards outlined by the *National Register Bulletin 15: How to Apply the National Register Criteria for Evaluation,* to evaluate whether the subject property retains sufficient integrity to convey its historic significance. Seven variables, or aspects, that define integrity are used to evaluate a resource's integrity—location, setting, design, materials, workmanship, feeling, and association. A property must possess most, or all, of these aspects in order to retain overall integrity. If a property does not retain integrity, it can no longer convey its significance and is therefore not eligible for listing in local, state, or national registers.

The seven aspects that define integrity are defined as follows:

Location is the place where the historic property was constructed or the place where the historic event occurred;

Setting addresses the physical environment of the historic property inclusive of the landscape and spatial relationships of the building(s);

Design is the combination of elements that create the form, plan, space, structure, and style of the property;

Materials refer to the physical elements that were combined or deposited during a particular period of time and in a particular pattern or configuration to form the historic property;

Workmanship is the physical evidence of the crafts of a particular culture or people during any given period in history or prehistory;

Feeling is the property's expression of the aesthetic or historic sense of a particular period of time; and

Association is the direct link between an important historic event or person and the historic property.

[30] California Office of Historic Preservation, *Technical Assistance Series No. 7: How to Nominate a Resource to the California Register of Historical Resources* (Sacramento: California Office of State Publishing, 4 September 2001) 11; U.S. Department of the Interior, National Park Service, *National Register Bulletin 15: How to Apply the National Register Criteria for Evaluation* (Washington, D.C.: National Park Service, 1995) 44.

Location
The Boathouse retains integrity of location, as it has remained situated at its location of original construction since 1946.

Setting
The Boathouse largely retains integrity of setting. The Boathouse was constructed close to the entrance to the pier at the south end of the Cal Maritime campus following the regrading of the campus in the mid-1940s. While many additional structures have been erected on the campus since the completion of the Boathouse, the Boathouse has retained its original connection to the shoreline of Morrow Cove and is closely associated with the maritime activities that take place along the wharf, including the docking of the training ship. The various additional structures that have been erected near the Boathouse are temporary and utilitarian in nature and do not overwhelm the 1946 building. These buildings and structures do not block access between the Boathouse and the historic location of the pier or its access to the water of Morrow Cove. Overall, the Boathouse retains its relationship to the shoreline and its setting within the larger Cal Maritime campus.

Design
The Boathouse was designed by the California Department of Public Works, Division of Architecture and has remained largely unaltered since its erection in 1946. The building retains its overall form, massing, and material palette, and therefore its original design as a 1946 boathouse.

Materials
The Boathouse retains integrity of materials. While the building has been reroofed with asphalt shingles, and its original double-hung wood windows have been replaced with vinyl sash, the building retains its overall materials with wood shingle and vertical wood siding, original wood doors, timber pier foundations, and internal steel framing.

Workmanship
The Boathouse was designed to serve a utilitarian function as an active boathouse for Cal Maritime and has minimal decorative features. Features providing evidence of period workmanship and construction methods include its structure, which sits over the water on timber piers, its vertical wood cladding and shingles, and its original wood doors. The Boathouse retains its original materials and design elements that demonstrate the workmanship of the period.

Feeling
The Boathouse retains integrity of feeling as a working boathouse that was constructed in 1946 to serve the students of Cal Maritime and provides an essential connection between the school and the waterfront of Morrow Cove. The building is closely identified with the maritime focus of the Academy, serves an integral function for the maintenance and storage of small watercraft, and provides a key educational space for the cadets of the Academy. The building retains its location and setting that directly relate to the feeling of the building as a boathouse, and the building continues to represent the early history of the Cal Maritime campus as it was just being established.

Association
The Boathouse retains its integrity of association with the early period of construction of the Cal Maritime campus and the maritime purpose of the Academy through the retention of the Boathouse's materials, design, setting, and feeling.

Overall, the Boathouse retains all seven aspects of integrity such that it conveys its significance under Criterion A/1, with a period of significance of 1946.

Character-Defining Features
For a property to be eligible for national or state designation under criteria related to type, period, or method of construction, the essential physical features (or character-defining features) that enable the property to convey its historic identity must be evident. These distinctive character-defining features are the physical traits that commonly recur in property types and/or architectural styles. To be eligible, a property must clearly contain enough of those characteristics to be considered a true representative of a particular type, period, or method of construction, and these features must also retain a sufficient degree of integrity. Characteristics can be expressed in terms such as form, proportion, structure, plan, style, or materials.

The character-defining features of the Boathouse include, but are not limited to:

Exterior Features
- Waterfront location with close relationship to the wharf
- Building partially extends over the water
- One-story volume with a cross-gable roof
- Dock at the west side of the sail loft portion of the building
- Wood walkway along the southwest edge of the building

- Mixture of wood shingle cladding and vertical wood cladding
- Original wood doors with an applied cross-brace pattern
- Large, gridded arrangements of fixed windows
- Evenly spaced window openings with the character of one-over-one double-hung window type along the south and west façades of the sail loft portion of the building
- Large opening for boat slips

Interior Features

- Two main volumes consisting of the sail loft and the transverse wing
- Organization of the transverse wing with its work platform, boat slips, and elevated rear storage aisle
- Original wood flooring throughout the building, including wood steps
- Original wood doors with applied cross brace pattern (including the barn door between the sail loft and the transverse wing, and the door to the kitchen, originally the canvas locker)
- Wood railing and metal ladders between the elevated rear storage aisle and the boat slips

Features that are not character-defining features of the Boathouse consist of alterations that have been made to the building since its construction in 1946. These include, but are not limited to:

- Replacement windows (vinyl replacement windows are not historic)
- Non-original doors installed at the south and east façades
- Non-original windows installed at the east façade of the sail loft
- New openings with aluminum slider windows located at the east façade of the transverse wing
- In-wall air conditioning unit at the west façade

California State Historical Landmark

California State Historical Landmarks are sites, buildings, features, or events that are of statewide significance and have anthropological, cultural, military, political, architectural, economic, scientific or technical, religious, experimental, or other value. Nominated by the State Historic Resources Commission, all properties listed as a California State Historical Landmark are automatically listed on the California Register. All landmarks must address one of the following criteria for designation.[31]

Criterion 1: The first, last, only, or most significant of its type in the state or within a large geographic region (Northern, Central, or Southern California).

Cal Maritime, originally known as the California Nautical School, was established in 1929 and accepted its first students in 1931, operating temporarily from the U.S. Navy Coaling Station near Tiburon in Marin County until 1939. With the onset of World War II, the school was temporarily relocated to several pier buildings in San Francisco before construction plans for its permanent campus on Morrow Cove in Vallejo came to fruition between 1942 and 1945. Cal Maritime was the first, and remains to be the United States' only, maritime academy located on the West Coast. The propagation of the school through the 1940s reiterates its critical role in the training and supplying of naval officers and its unique proximity to American maritime defense operations in the Pacific region during World War II.

Completed in 1946, the Boathouse was the second-constructed building at the new Vallejo campus (shortly after Mayo Hall in 1945) and was important to the school's ongoing development and success. The building is illustrative of the vital connection between the campus, its curriculum, and the waterfront. However, the Boathouse is not the first, last, only, or most significant of its type in the state or within Northern California and does not carry the necessary level of significance as an individual building to be recommended as eligible for listing as a California State Historical Landmark under Criterion 1.

Criterion 2: Associated with an individual or group having a profound influence on the history of California.

The Boathouse at Cal Maritime does not have a significant association with any individual person or group having a profound influence on the history of California. It has been associated with many teachers and students since the 1940s. It has been associated with many teachers and students since the 1940s. It was dedicated to retired U.S. Naval Commander Edwin C. Miller in 1989 in recognition of his ongoing relationship with and many contributions to the school, including his years as a student (class of 1934), teacher, and Interim President (1971 – 1972). However, Miller's career is not directly associated with the Boathouse building within the Cal Maritime campus, and this name dedication appears to simply be in his honor.

[31] California Office of Historic Preservation, "California Historical Landmarks Registration," accessed online January 4, 2024, https://ohp.parks.ca.gov/?page_id=21747#:~:text=Criteria%20for%20Designation&text=The%20first%2C%20last%2C%20only%2C,on%20the%20history%20of%20California.

Therefore, the Boathouse does not appear to be eligible for individual listing as a California State Historical Landmark under Criterion 2.

Criterion 3: A prototype of, or an outstanding example of a period, style, architectural movement, or method of construction or is one of the more notable works or the best surviving work in a region of a pioneer architect, designer, or master builder.

The Boathouse at Cal Maritime is not a prototype of nor an outstanding example of a period, style, architectural movement, or method of construction. It was designed in 1945 in a utilitarian style by the California Department of Public Works, Division of Architecture to serve as an educational building and small boat storage and maintenance facility for the campus. It is not a notable work nor a best surviving example of a pioneer architecture, designer, or master builder of the region. Completed in 1946, the building has undergone some alterations to both its exterior and interior, but remains largely intact in regard to its materials, form, massing, and relationship to the waterfront of Morrow Cove and an adjacent pier (reconstructed in 1995-1997 to replace the 1940s wood wharf) where Cal Maritime's training ship is regularly docked. While the Boathouse building was critical to the overall development and success of the relocated Cal Maritime campus (from Tiburon, Marin County to Vallejo, Solano County circa 1942), it is not a unique representative of an architectural movement. Therefore, the Boathouse does not appear eligible for listing as a California State Historical Landmark under Criterion 3.

Conclusion

Cal Maritime was originally established as the California Nautical School in 1929 and was one of four degree granting maritime academies operating in the United States. The school was renamed the California Maritime Academy in 1939, and joined The California State University system in 1995, becoming the California State University Maritime Academy. The establishment of the current campus at Morrow Cove in Vallejo was a significant investment by the state and federal government during World War II that illustrated the growing need to train maritime officers who would go on to careers in the nation's maritime industries, whether that is related to naval defense or the merchant marine. The Cal Maritime campus was established at Morrow Cove in the 1940s with a permanent building campaign started in 1943.

The Boathouse, as one of the earliest permanent structures established at the campus, appears to be significant for individual listing in the National Register and the California Register under Criterion A/1 (Events) as a building that was critical to the development and success of the new campus and demonstrates the recognition of the importance of Cal Maritime in the support of national maritime industries. The Boathouse also serves an important role in demonstrating the connection of the campus to the waterfront in a way that other early permanent buildings on the campus, like Mayo Hall, do not. Under Criterion A/1, the Boathouse has a period of significance of 1946, corresponding to the year the building was completed. The California Historical Resource Status Codes (CHRSC) of "3S" and "3CS" have been assigned to the property, meaning "Appears eligible for NR individually through survey evaluation" and "Appears eligible for CR as an individual property through survey evaluation" respectively.[32]

The Boathouse does not appear to be eligible for individual listing as a California Historical Landmark under any criteria.

The Boathouse appears to be an individual historic resource for the purposes of CEQA, California Public Resources Code (PRC) 5024 review, and Section 106 review.

[32] California Office of Historic Preservation, *California Historic Resource Status Codes*, Sacramento, Updated March 2020.

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Supplementary Materials

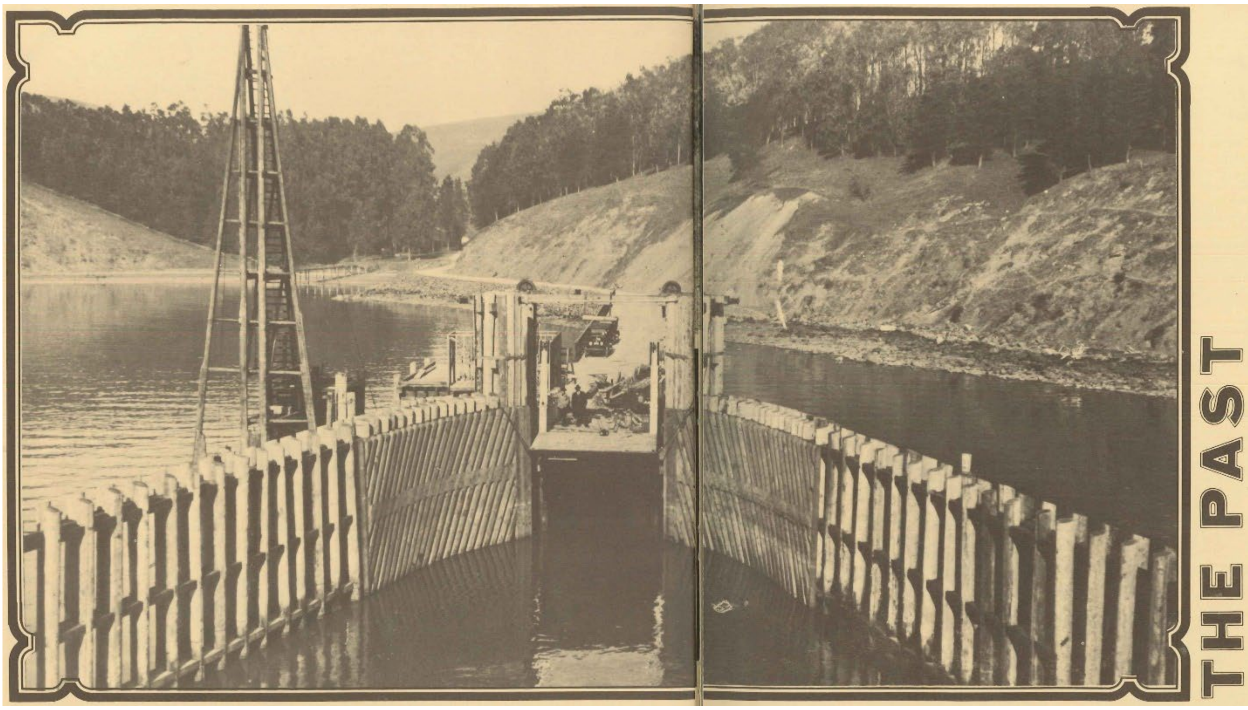

Figure 26: Undated photograph of the ferry slip at Morrow Cove where automobiles would be loaded onto the ferry to cross the Strait. Source: *Hawsepipe,* 1979.

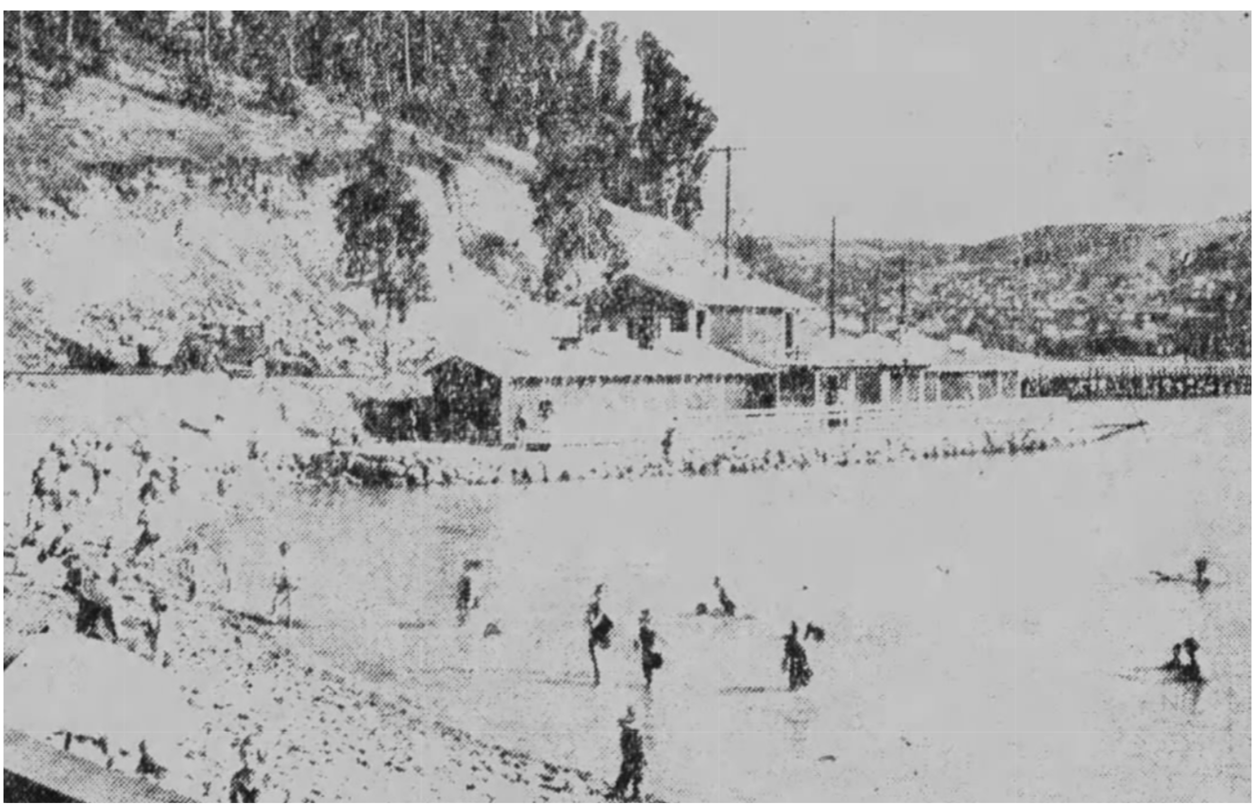

Figure 27: View of recreation area at Morrow Cove in 1933. Source: *The Oakland Tribune,* May 1933.

Figure 28: Photograph of Morrow Cove taken by Edwin C. Miller in December 1940, while at the site as part of a survey party of Maritime Academy administrators. Existing piers and structures were fully removed by 1946. At the far right is the *Contra Costa*, which served as a breakwater. Source: Cal Maritime, Campus History Collection.

Figure 29: View of the shoreline c. 1943 showing the completed wharf in the background with the T.S. Golden State. The old pier is partially extant, and the hulls of the *Contra Costa* and the *Bangor* are visible, prior to the regrading of the site. The Boathouse had not been constructed at this time. Source: *Hawsepipe*, 1979.

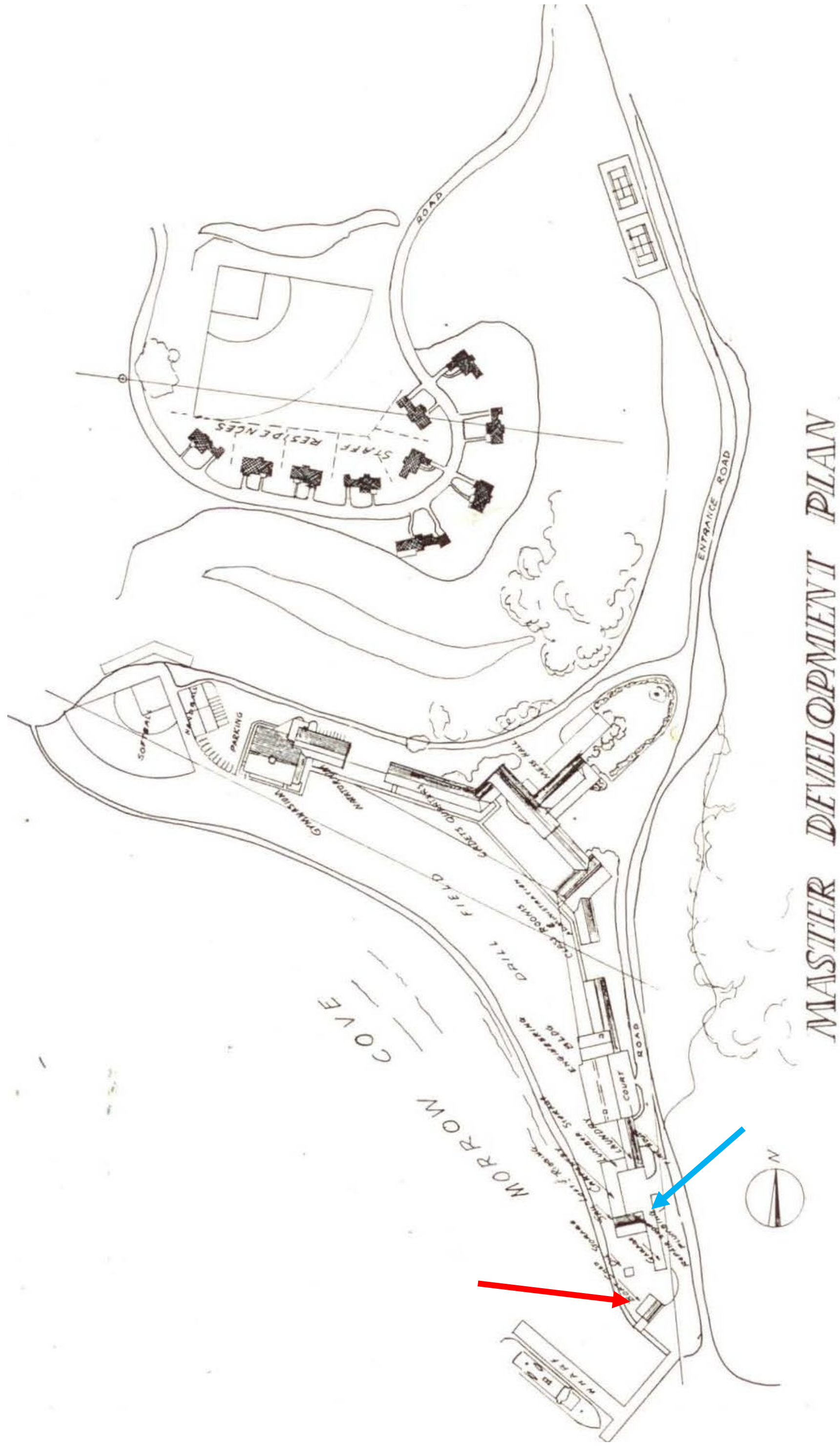

Figure 30: Master Development Plan for the Cal Maritime campus, c. 1945. Red arrow shows the location of the proposed Boat Shed; blue arrow shows the location of the proposed Sail Loft. Source: *Pacific Marine Review,* October 1945. Edited by Page & Turnbull.

Figure 31: Aerial photograph of the Cal Maritime campus with Vallejo in the background (top left of the image), c. 1961. Source: Cal Maritime Campus History Collection.

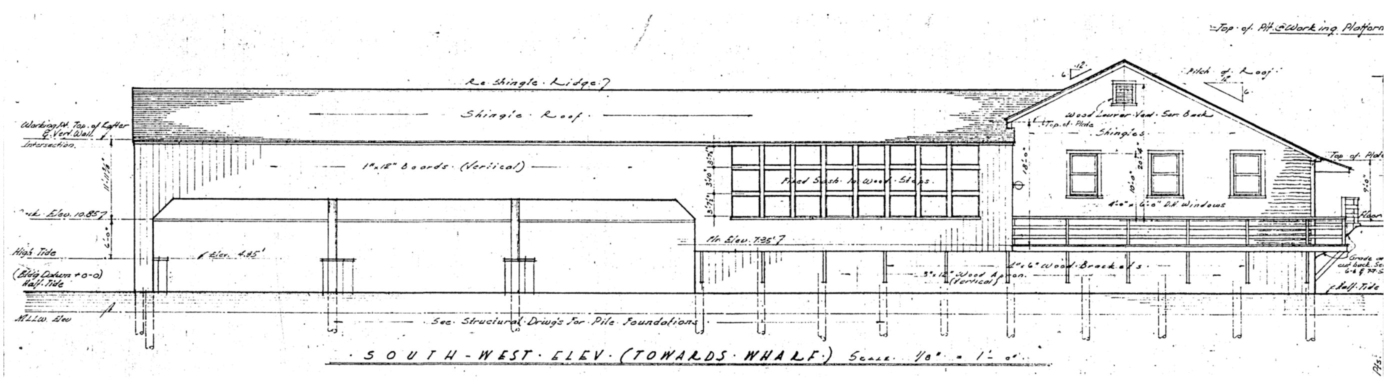

Figure 32: Detail of original drawing of Boathouse, dated December 1945. Source: Cal Maritime administration.

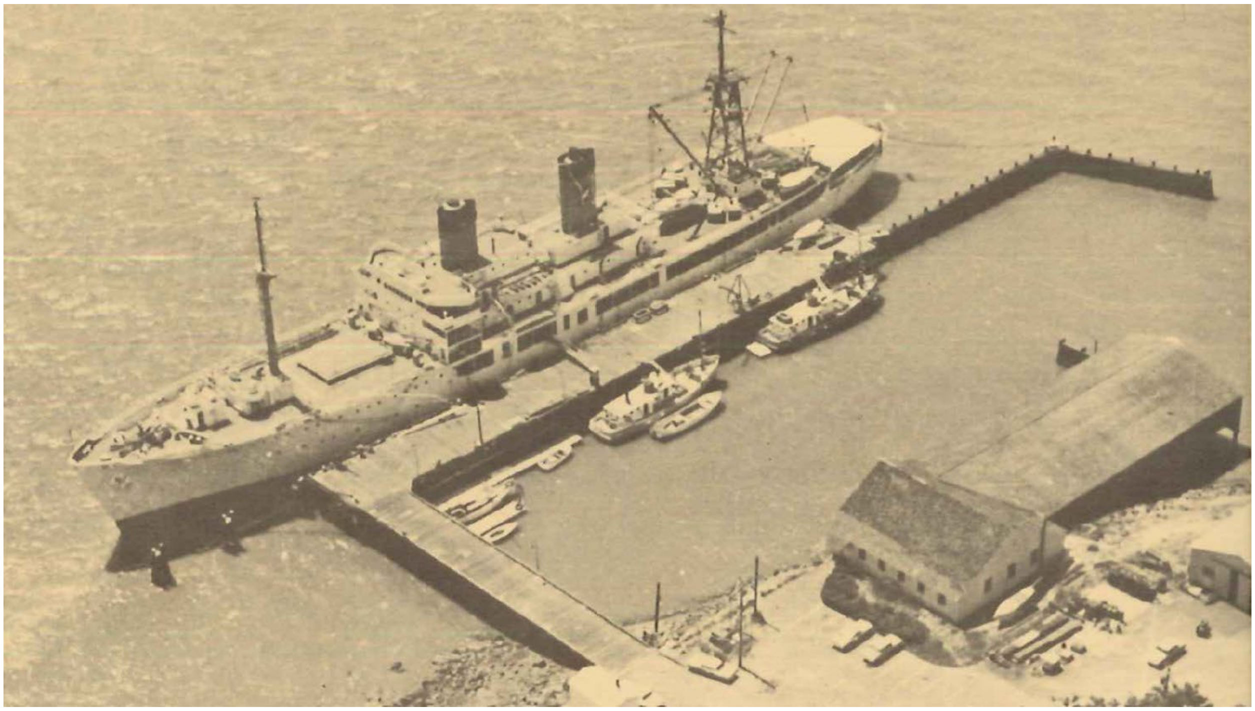

Figure 33: View of the Boathouse and docked ship, c. 1946. Source: *Hawsepipe*, 1979, Cal Maritime Campus History Collection.

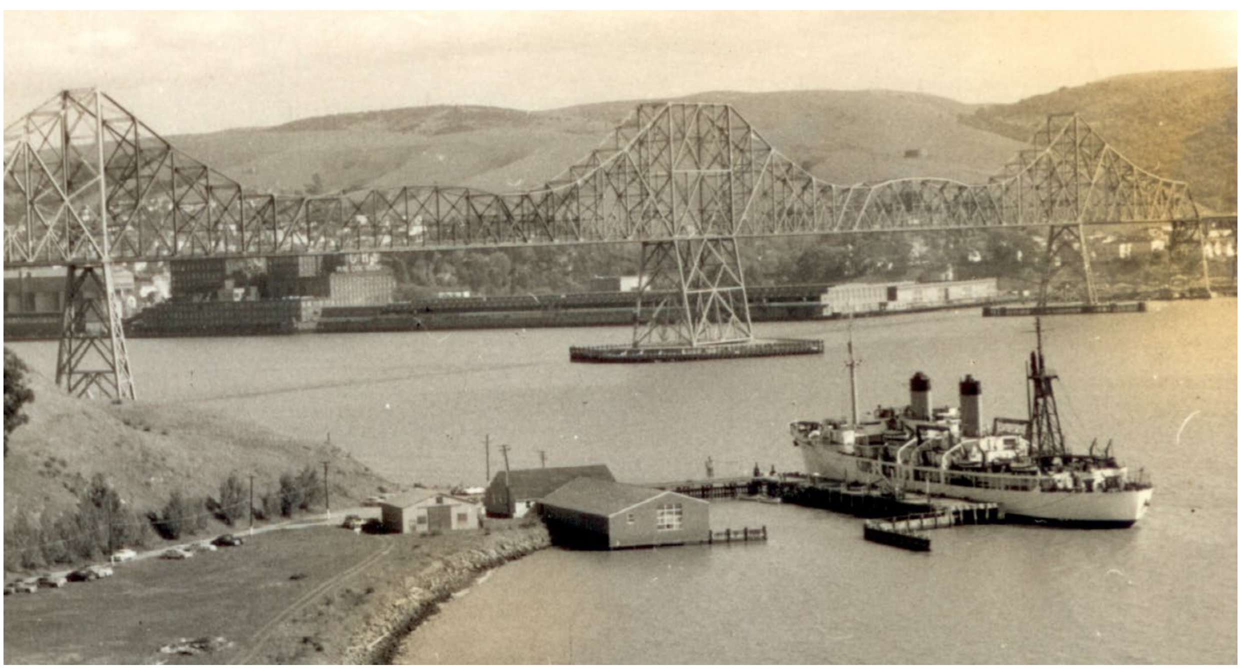

Figure 34: Looking south over the Boathouse and wharf, towards the Carquinez Bridge, c. 1948. Source: Cal Maritime, Campus History Center.

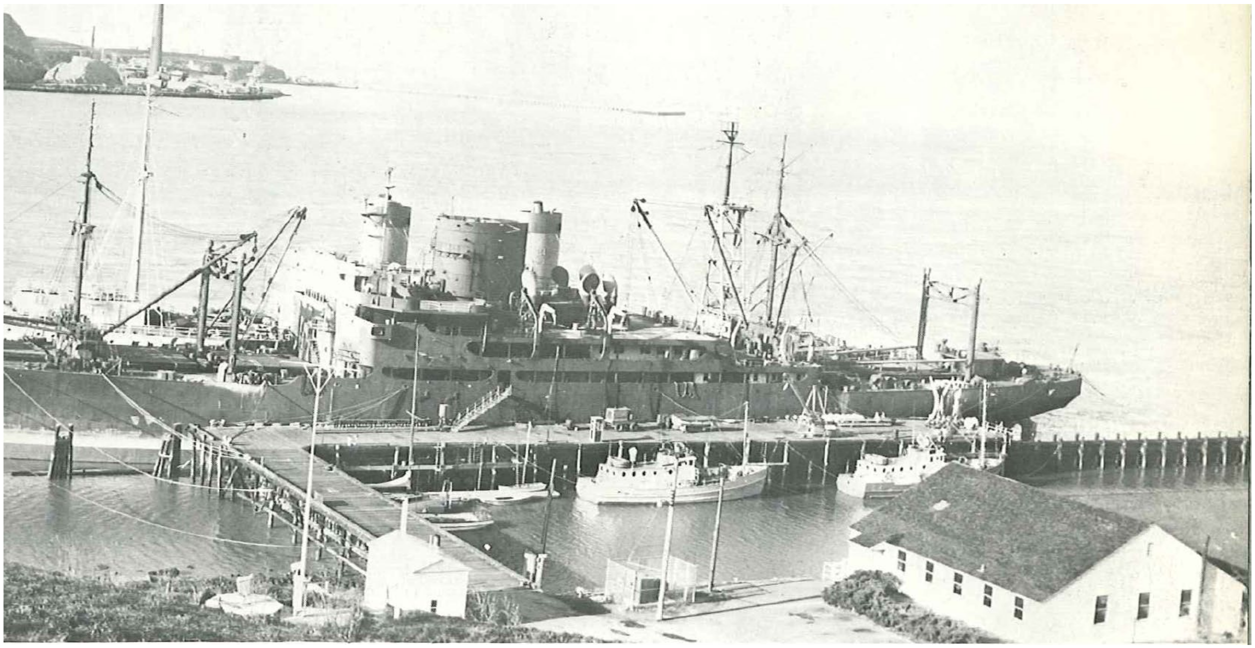

Figure 35: View of the Boathouse and wharf, c. 1971. Source: *Hawsepipe*, 1971, Cal Maritime Campus History Collection

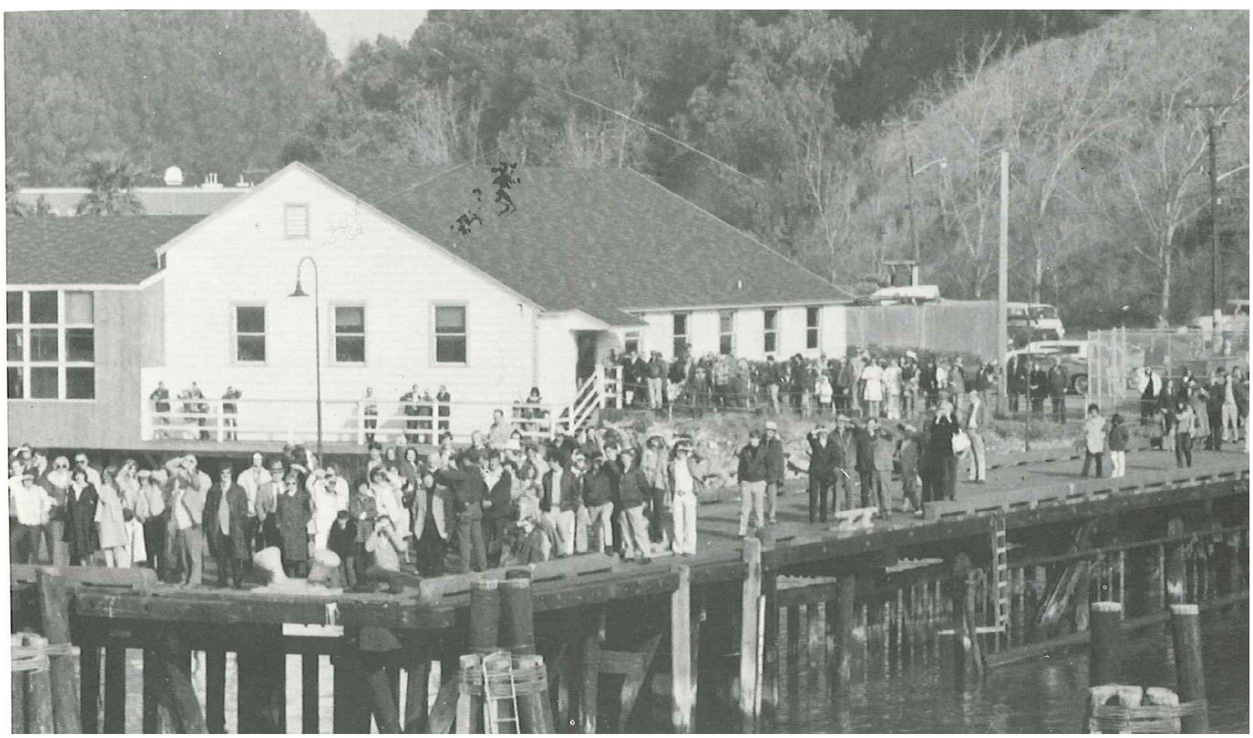

Figure 36: View of Boathouse, 1976. Source: *Hawsepipe*, 1976, Cal Maritime Campus History Collection

Figure 37: South façade of the Boathouse, door at far left of frame present by 1989. Source: *Hawsepipe*, 1990, Cal Maritime, Campus History Collection.

Figure 38: View showing the west façade of the Sail Loft portion of the Boathouse, 2008. Source: *Hawsepipe,* 2008, Cal Maritime, Campus History Collection.

Additional Historic Photographs of the Cal Maritime Boathouse

Figure 39: View of the Cal Maritime campus, 1946. Source: *Hawsepipe*, 1946, Cal Maritime Campus History Collection.

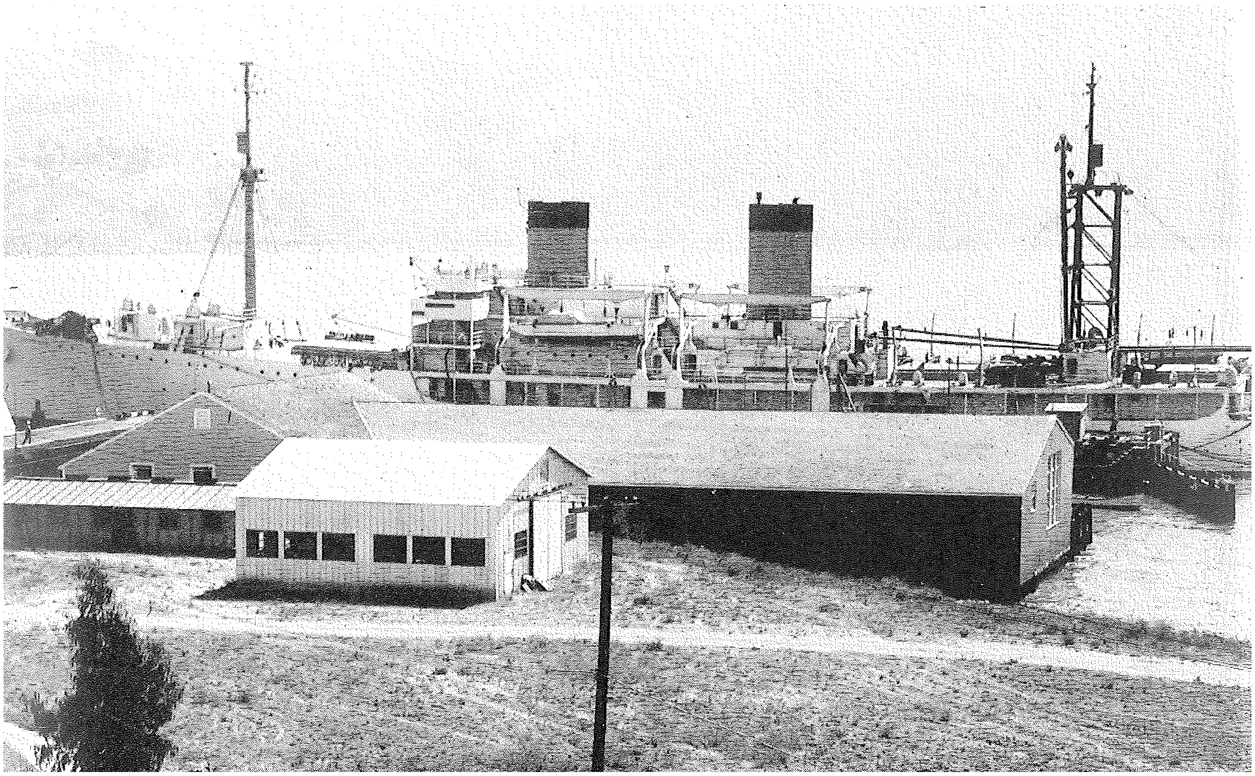

Figure 40: View of the Boathouse and wharf, 1949. Source: *Hawsepipe*, 1949, Cal Maritime Campus History Collection.

Figure 41: Aerial view of the Cal Maritime campus, 1957. Source: Cal Maritime Campus History Collection.

Figure 42: View of the Boathouse, 1958. Source: Cal Maritime, Campus History Collection.

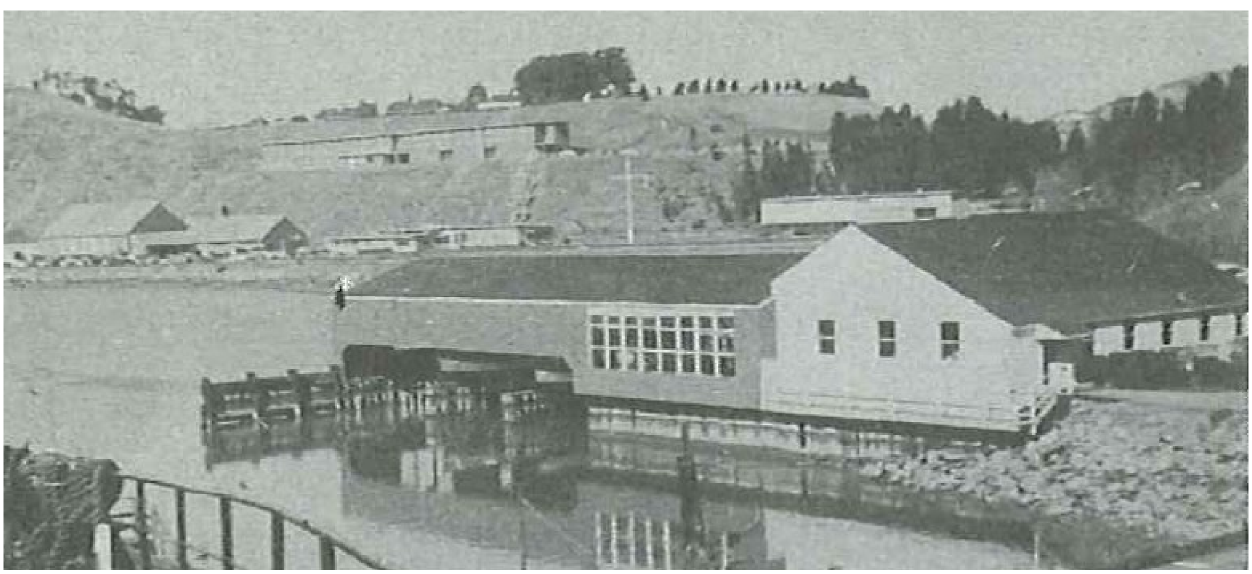

Figure 43: View of the Boathouse from the Golder Bear, 1959. Source: *Hawsepipe*, 1959, Cal Maritime Campus History Collection.

Resource Name or # Cal Maritime Boathouse
***Recorded by** Page & Turnbull, Inc. ***Date** January 24, 2024 ☒ Continuation ☐ Update

Figure 44: View of the campus looking south, c. 1959, with foundations underway for Dwyer Hall. East façade of Boathouse is visible in background. Source: Cal Maritime Campus History Collection.

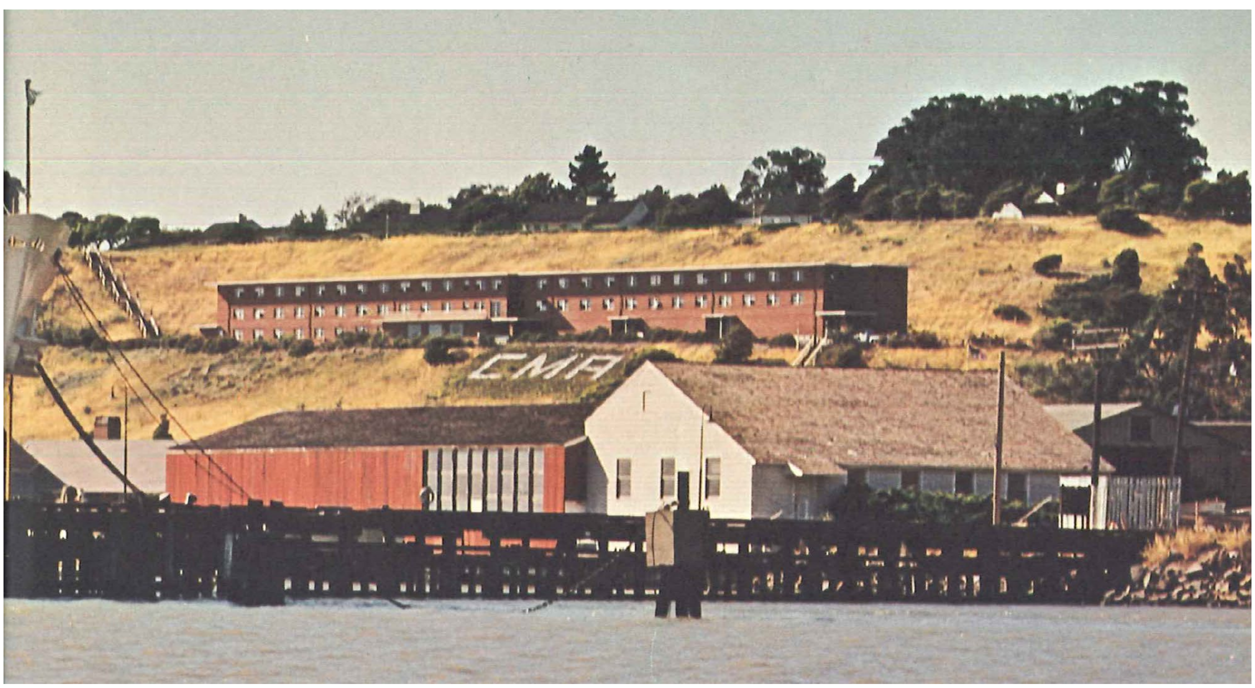

Figure 45: View of the campus with the Boathouse, c. 1968. Source: *Hawsepipe*, 1968, Cal Maritime Campus History Collection

Figure 46: West and south façades of the Boathouse,1960s. Source: Cal Maritime Campus History Collection.

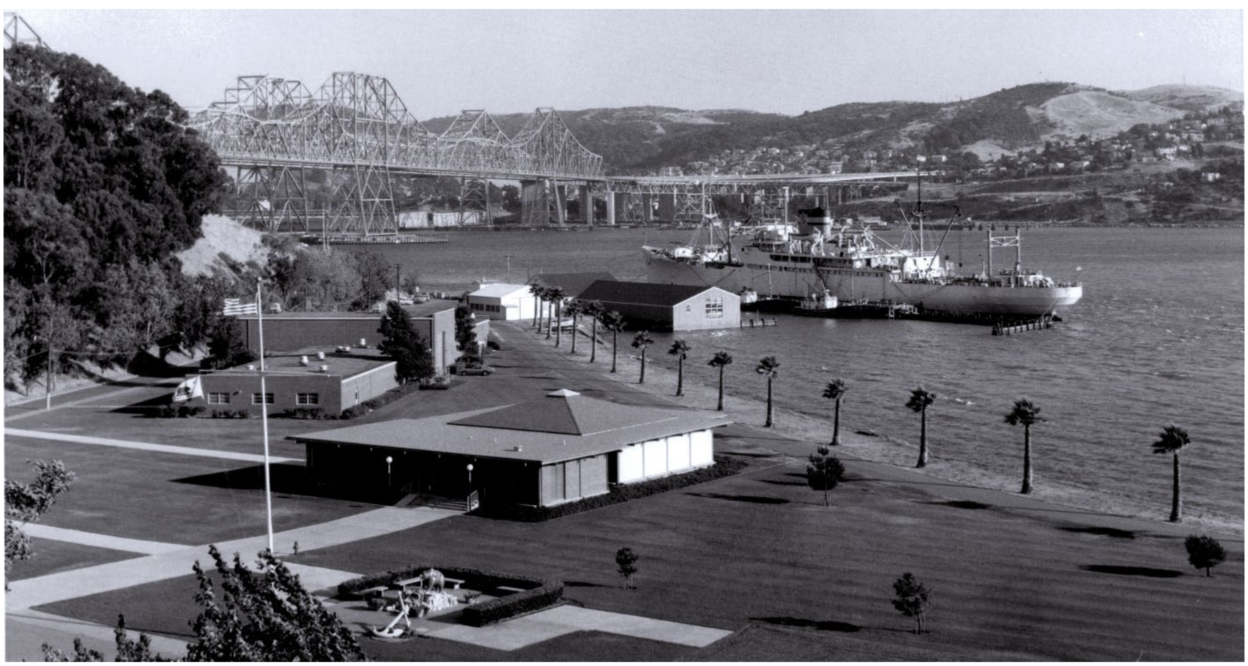

Figure 47: Boathouse in background, c. 1971. Source: Cal Maritime Campus History Collection.

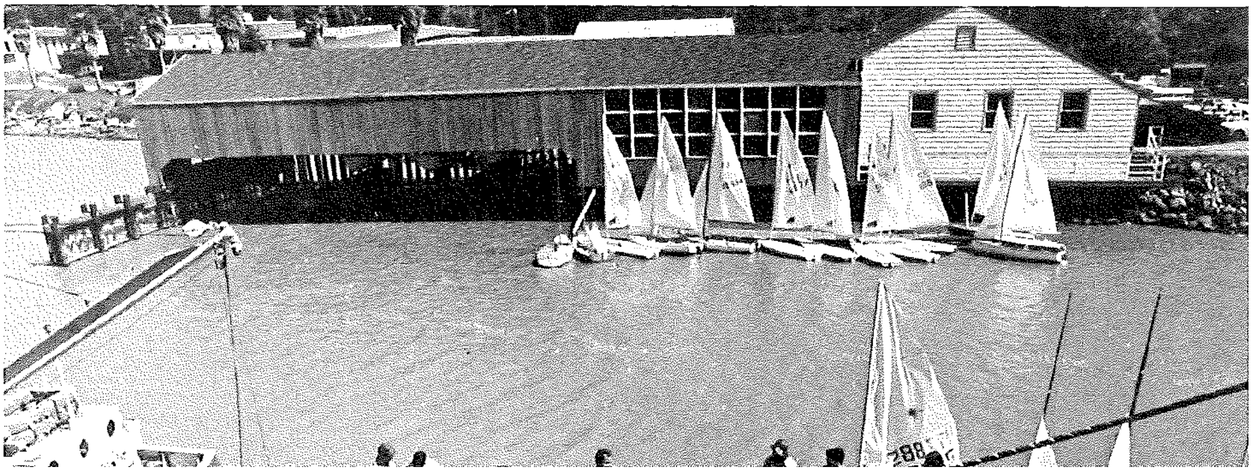

Figure 48: West façade of the Boathouse, c. 1978. Source: *Hawsepipe*, 1978, Cal Maritime Campus History Collection.

Appendix D – Statement of Qualifications

This Historic Resource Evaluation was prepared by Page & Turnbull of San Francisco, California. Page & Turnbull staff responsible for this report include Ruth Todd, FAIA, Principal-in-charge; Christina Dikas, Senior Architectural Historian and project manager; Barrett Reiter, Architectural Historian and primary author, and Maggie Nicholson, Cultural Resources Planner, all of whom meet or exceed the Secretary of the Interior's Professional Qualification Standards for Historic Architecture, Architectural History, or History.

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Appendix G

Section 106 Technical Report

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CALIFORNIA STATE UNIVERSITY MARITIME ACADEMY

CAL MARITIME WATERFRONT MASTER PLAN PROJECT: SECTION 106 TECHNICAL REPORT

SOLANO COUNTY, CALIFORNIA
[21067.1]

PREPARED FOR THE DEPARTMENT OF TRANSPORTATION, MARITIME ADMINISTRATION (MARAD)
April 8, 2024

DRAFT

TABLE OF CONTENTS

I. INTRODUCTION

The California State University Maritime Academy (referred to as Cal Maritime) is proposing to complete a phased Waterfront Master Plan that would prepare the waterfront and its Main Dock for the arrival of a new training ship, would renovate the existing historic 1946 Boathouse, and complete several waterfront and boat basin improvements. The Cal Maritime campus is located in Vallejo, Solano County, California, on approximately 92 acres of land owned by the California State University (CSU) system, inclusive of various historic and non-historic buildings and structures as well as approximately one half-mile of waterfront along San Pablo Bay at Morrow Cove. The waterfront is the campus' dominant natural feature and the focal point of Cal Maritime instruction and activities, particularly those associated with the CSU Maritime Boathouse and the current Training Ship *Golden Bear* (TSGB). The Boathouse, which was constructed in 1946 and designed in a utilitarian style by the California Department of Public Works, Division of Architecture, is located at the southeastern end of the campus between the intersection of Maritime Academy Drive and Morrow Cove Drive and the Main Pier, the docking location of the TSGB.

The proposed Cal Maritime Waterfront Master Plan project seeks to implement a variety of on-land and in-water infrastructure improvements along the campus waterfront to be constructed in three phases over the next approximately 10 years. A new training ship, the *National Security Multi-Mission Vessel* (NSMV), is planned to replace the TSGB in April 2026, and necessary alterations to the Main Dock needed to accommodate the NSMV will be funded by the United States Department of Transportation Maritime Administration (MARAD), The NSMV will remain part of MARAD's National Defense Reserve Fleet and could be called into national service. When not in service for MARAD, the vessel will be docked at Cal Maritime's improved main pier for use as classroom space, hands-on training, and other educational activities that support the mission of Cal Maritime.

As defined in 36 Code of Federal Regulations (CFR) § 800.16(y), a Federal Undertaking is a project, activity, or program funded in whole or in part under the direct or indirect jurisdiction of a Federal agency, including those carried out with Federal financial assistance and those requiring a Federal permit, license, or approval. The proposed project would be considered Federal Undertakings as defined in 36 CFR § 800.16(y), thereby necessitating compliance with the procedural requirements of the National Historic Preservation Act (NHPA) and its implementing regulations. MARAD is the lead federal agency for this Section 106 consultation process.

Purpose

The purpose of this document is to provide necessary information for Section 106 consultation and identify potential impacts to the historic Cal Maritime Boathouse, which has previously been determined to be eligible for the National Register of Historic Resources (National Register) and the

California Register of Historical Places (California Register). The Boathouse is located within the Area of Potential Effects (APE) for the Cal Maritime Waterfront Master Plan Undertaking, pursuant to 36 CFR § 800.4, and the application of the Criteria of Adverse Effects, pursuant to 36 CFR § 800.5(a).

This document focuses on an analysis of the potential impacts of the Undertaking on the historic Cal Maritime Boathouse. Separate technical analyses have been prepared to address the potential impacts of the undertaking on archaeological resources. These include reports addressing terrestrial archaeological properties, prepared by Natural Investigations Company, and the underwater archaeological properties, prepared by Far Western Anthropological Research Group.

Location

Cal Maritime's 92-acre campus in Vallejo, Solano County, California (Assessor's Parcel Number 006-209-0030) is generally bounded by Interstate 80 on the east, Morrow Cove on the south and west, and Carquinez Highlands Mobile Home Park and Sandy Beach Road on the north. A location map identifying the Cal Maritime campus is included as **Appendix A**.

The Cal Maritime Waterfront Master Plan Undertaking is proposed to occur within approximately 31 of the campus' 92 acres. Within the campus boundary, the proposed project areas would be located on the south end of the campus and include approximately four on-land acres, one-half mile of shoreline, and 27 acres of the adjacent waters of Morrow Cove. The southeastern edge of the waterfront contains the Boathouse, boat basin, and Main Pier, where the TSGB is docked.

Methodology

This report provides a description of the proposed Undertaking, with a focus on the proposed work that relates to the historic Boathouse, describes the Area of Potential Effects (APE), identifies historic buildings within the APE, and concludes with findings. Supporting material that was referenced and reviewed for the creation of this report include: *National Register Bulletin 15: How to Apply the National Register Criteria for Evaluation*, *Cultural Resources Assessment for the California State University Maritime Academy Waterfront Master Plan, Solano County, California* completed for the Cal Maritime campus in 2023, and State of California Department of Recreation (DPR) 523 Forms for the historic Boathouse building (2022, revised 2024).[1] Additional material regarding environmental and archaeological impacts and consultation/outreach have been produced by Ascent Environmental, Natural Investigations Company, and Far Western Anthropological Research Group.

[1] National Park Service, *National Register Bulletin 15: How to Apply the National Register Criteria for Evaluation*, National Park Service: 1990, revised 1997. Accessed January 24, 2024, https://www.nps.gov/subjects/nationalregister/upload/NRB-15_web508.pdf; Page & Turnbull. DPR 532 Forms, "Cal Maritime Boathouse," 2022, revised 2024.

Supporting materials, contained with this report's appendices, include the following:

- **Appendix A:** Location map and APE map for the proposed Cal Maritime Waterfront Master Plan Undertaking.
- **Appendix B:** DPR 523 forms for *Cal Maritime Boathouse*, which were prepared for the *Cal Maritime Boathouse Historic Resource Evaluation* (2022, revised 2024).
- **Appendix C:** DPR 523 forms for *Cal Maritime Machine Shop* (2024).

The historic context and evaluation of the historic Boathouse building on the Cal Maritime campus is largely based on the revised 2024 "Cal Maritime Boathouse" DPR 523 forms.[2] This report identified the Cal Maritime Boathouse as eligible for listing in the National Register and California Register under Criterion A/1 (Events) with a period of significance of 1946. Minor additional research, including review of historic aerials, was completed to establish the age or eligibility of the other buildings or structures within the Cal Maritime Waterfront Master Plan APE.

[2] Page & Turnbull. DPR 532 Forms, "Cal Maritime Boathouse," 2022, revised 2024.

II. DESCRIPTION OF UNDERTAKING

The following description and location information for the improvements associated with the proposed Cal Maritime Waterfront Master Plan Undertaking are based on conceptual drawings and specifications prepared by Moffett & Nichol and Cal Maritime and dated August 25, 2022. These materials were provided to Page & Turnbull by Ascent Environmental on January 18, 2024.

CAL MARITIME WATERFRONT MASTER PLAN UNDERTAKING

The Cal Maritime Waterfront Master Plan establishes a vision for achieving a campus waterfront aligned with the unique academic and maritime operations, environmental factors, and resiliency needs of Cal Maritime. Proposed activities for the Cal Maritime Waterfront Master Plan Undertaking include upgrades to in-water infrastructure, renovation and development of waterfront buildings, enhancement of waterfront open space and connectivity, and expansion of site-serving utilities. The Undertaking is divided into three phases of development that would be completed over the next 10 years. The proposed renovations specifically associated with the historic Boathouse building and upgrades to its surrounding site would be completed within Phase Two of the Undertaking and are the focus of this report.

As part of Phase One, upgrades to the Marine Yard inside the MARSEC (Maritime Security)-secured perimeter, which links the gatehouse to the pierhead and contains the Boathouse's primary (east) façade, would be limited to those needed to support the new pier and extended trestle for the NSMV. These upgrades would not impact the historic Boathouse. The upgraded Marine Logistical Yard would be resurfaced to an expanded 21,680 square-feet (just under a half-acre). Utilities and storage areas would shift to zones created as part of Phase Two and Phase Three of the master plan and along the perimeter of those areas. The purpose of this proposed shift would be to create the largest operational zone possible for academic program functions and the overall logistical needs of the main pier and area. The upgraded Marine Logistical Yard would also be able to accommodate marine research containers, provisions staging, cranes, and outdoor shop(s) operation with cadets, faculty, and tradespeople, of which none would come into direct contact with nor impact the historic Boathouse building.

As part of Phase Two, Boathouse renovations would address needed seismic upgrades and tectonic modifications of the existing structure, including foundation improvements and the installation of new structural piles (both below ground and underwater). Sediment removal would be required as part of this underwater effort. The headhouse would be reverted to its originally intended use as a sail loft, and non-historic partitions would be removed to bring the headhouse back to a single open space. Proposed interior upgrades include the installation of a barrier-free, ADA-compliant lift servicing the split ground-floor level. General upgrades and accessibility improvements are also planned for the restroom. Electrical and plumbing systems would also be improved.

Although limited redesign and reconfiguration of the lower-level woodworking and vessel service/demonstration areas are proposed, overall, most of the spaces would be protected and preserved to maintain historic value. Some timber piles may require replacement; however, the exact number is unknown at this time. It is anticipated that the size and types of piles would be steel piles installed via pile-driver impaction, or with rock anchoring or rock socketing methods.

Though the exact scope of this Phase Two work as it pertains to the historic Boathouse building is being refined, the overall approach would be to retain the building's existing original materials and existing exterior openings (e.g., door and window openings), which would not be altered or resized in any way. In instances where doors and/or windows may require replacement, only in-kind or historically appropriate alternatives would be considered. In instances where existing non-historic materials require replacement, the same logic shall apply in order to return more materiality of the building to a historically appropriate state.

The portion of the Marine Yard located outside the MARSEC-secured perimeter contains the Marine Programs and Naval Science Modular structures and runs parallel to and within close proximity to the Boathouse's north façade. During Phase Two activities, the existing Marine Programs and Naval Science modular buildings would be demolished and removed, restoring public visibility of the Boathouse's historic north façade. This portion of the Marine Yard (outside the MARSEC-secured perimeter) is slated to be transformed into a pedestrian-oriented plaza with a strong connection to the existing adjacent Simulation Center Plaza, which is located inside the U-shaped intersection of Morrow Cove Drive and Maritime Academy Drive. This Boathouse Forecourt area of the Marine Yard would serve functional activities related to the NSMV and would contain staging, storage, and truck access as well as public seating areas. Landscape improvements, including a transitional planting zone, paved pedestrian paths, and a public pier with a lookout and waterfront plaza, along the shoreline would visually connect the Boathouse Forecourt of the Marine Yard to other parts of the waterfront.

The hardscape and landscape elements for the Boathouse Forecourt of the Marine Yard have only been developed to a Schematic Design level, and are proposed to include circular paving patterns, a seat wall feature, and ornamental plantings. The design intent is to emphasize the visual corridor, maintain the vehicular/pedestrian connections, and create a focal point at the terminus of Morrow Cove Drive and Maritime Academy Drive that is similar to Alumni Plaza on the north side of Morrow Cove Drive which was installed in 2008. The design would establish a new pedestrian connection between the renovated Boathouse and the new Marine Programs and Naval Science Replacement

Building (envisioned in Phase Three); would create ample space for vehicular circulation, including truck turning radii; provide flexible functional space for demonstration and outdoor learning purposes; and create continuous visual and circulation shoreline linkages.

As part of Phase Three, a new Marine Programs Multi-Use Building is proposed for the northeast side of the expanded Marine Yard. This approximately 20,300 square-foot building would include a lookout and harbor control tower to stand between 50 and 60 feet in height. Closer to the center of campus, an esplanade, a canopy structure covering approximately 3,780 square-feet, and other shoreline improvements are proposed to better connect major campus axes to the central waterfront. These public-facing features would include paving, fire pits, educational signage, interactive furnishing elements, and lighting fixtures. Water's edge and underwater improvements propose mass grading and implementation of a transition zone, intertidal zone, and living reefs, but would not change the location or shape of the shoreline. Whereas intertidal zone improvements would create habitat for specific species as well as sea-level rise resilience, living reef improvements along the pier proposed in Phase Two would create habitat for oysters, eels, and mussels. Lastly, with the expanded floating docks and boat basins to be constructed within Phase Two, the Marine Hydrokinetic Barge (currently maintained in the open water of Morrow Cove) and a new two-story Row House would be incorporated into Cal Maritime's southeastern waterfront area.

III. AREA OF POTENTIAL EFFECTS

According to the implementing regulations of the NHPA, the Area of Potential Effects (APE) is "the geographic area or areas within which an undertaking may directly or indirectly cause alterations in the character or use of historic properties, if such properties exist. The area of potential effects is influenced by the scale and nature of an undertaking and may be different for different kinds of effects caused by the undertaking."[3] The APE should include all visual, audible, sociocultural, and indirect effects that may occur as a result of the Undertaking.

The APE for the Cal Maritime Waterfront Master Plan Undertaking was delineated to ensure identification of significant historic properties which are listed in or eligible for inclusion in the National Register and which may be directly or indirectly affected by undertaking activities. The APE was defined by Ascent Environmental, who provided the APE extent and maps to Page & Turnbull. The Cal Maritime Waterfront Master Plan Undertaking APE consists of those areas within which Undertaking-related activities are proposed, and where direct, physical impacts to archaeological, architectural, and landscape resources could therefore occur. The proposed Undertaking also has the potential to affect architectural and historic landscape resources in the APE which are outside of the project boundary through visual, audible, or atmospheric intrusions.

Cal Maritime Waterfront Master Plan Undertaking APE Boundaries

The Cal Maritime Waterfront Master Plan Undertaking APE measures approximately 31 acres, including about four acres on land along the campus' half-mile of waterfront and about 27 acres over the waters of Morrow Cove. The APE generally follows the gentle northwest-to-southeast curvature of the waterfront, which is located along Cal Maritime's southernmost campus boundary. The APE's north boundary generally aligns with the west façade of the Dining Center building and runs southeast to the southern periphery of the Marine Yard. The APE is bounded on the east-northeast by the western edge of Morrow Cove Drive. The Boathouse, in addition to the Marine Programs and Naval Sciences buildings, Alumni Plaza (south of the Simulation Center building), Marine Yard, Main Pier, boat basin, and the TSGB, are located within the boundaries of the APE as defined by the Cal Maritime Waterfront Master Plan Undertaking as shown in **Appendix A**.

The Vertical APE varies throughout the project boundaries of the Undertaking, and primarily would consist of minor regrading efforts along the shoreline. Ground disturbance associated with the Undertaking's proposed work within the southeastern section of the APE would include the excavation of utility trenches between Maritime Academy Drive, Morrow Cove Drive, and the Main Pier (inclusive of the Boathouse and Marine Yard) to a depth of approximately three to six feet as

[3] 36 CFR 800.16(d) "Protection of Historic Properties," amended August 5, 2004.

well as upgrades to site elements, including the installation of a new plaza, to a depth of approximately two to four feet. Deeper ground disturbance in localized areas is proposed as part of the underwater replacement of existing structural piles and some sediment removal/dredging in the area adjacent to the Boathouse. This dredging activity is expected to take place in areas previously disturbed by past dredging and would approach a depth of up to 11 feet below the mean low-water mark. Based on the existing bathymetry, the dredging would create bed disturbance up to nine feet below the existing bay floor.

IV. IDENTIFICATION OF HISTORIC PROPERTIES WITHIN THE APE

Section 106 of the NHPA requires that federal agencies take into account effects on historic properties that may be caused by undertakings and that the Advisory Council on Historic Preservation (ACHP) be afforded the opportunity to comment on those undertakings (16 USC 470a, 36 CFR § 800). Section 106 requires that historic properties be identified, that effects be analyzed, and, if adverse effects are expected, appropriate mitigation be identified and implemented under a Memorandum of Agreement (MOA). Historic properties under the NHPA include any district, site, building, structure, or object that is included in or eligible for listing in the National Register of Historic Places (NRHP, 36 CFR § 800.1).

The following sections describe Page & Turnbull's efforts to identify architectural/landscape resources within the APE that appear to qualify as historic properties for Section 106 review.

Architectural Properties

HISTORIC PROPERTIES

DPR 523 A and B forms for the Cal Maritime Boathouse were prepared in January 2022 and revised in January 2024 (**Appendix B**). This evaluation found the building eligible for the National and California Registers under Criterion A/1 (Events) for its significance as one of the Cal Maritime campus' earliest permanent buildings with a period of significance of 1946, which corresponds to the year of its completion. The Boathouse, in its use and its location along the waterfront, is closely associated with the establishment of the new campus. The creation of a purpose-built campus in the 1940s was a significant investment in the establishment of the California Maritime Academy that illustrated the important role that the school had played during World War II and recognized the importance of retaining and supporting the only degree-granting maritime academy on the West Coast. Therefore, the Boathouse is a historic property located within the Cal Maritime Waterfront Master Plan Undertaking APE.

The Cal Maritime Boathouse is a one-story, wood-frame building located adjacent to the pier and berth for the existing TSGB. The Boathouse is L-shaped in plan, with its primary entrance on the east façade of the building, which sits on land and faces a small, paved parking area located immediately north of the Main Pier. The north end of the Boathouse projects over the water of Morrow Cove to allow for boat slips along the north end of its west façade. To the west (left) of the primary entrance door, a wood staircase with a wood railing descends to a small wood walkway and dock along the west façade that also extends over the water. The Boathouse's south façade and dock and the

TSGB's berth constitute the boundaries of Cal Maritime's existing boat basin, near the foot of the Carquinez Bridge.

The character-defining features of the Cal Maritime Boathouse, as stated in the Cal Maritime Boathouse DPR forms, include the following:

Exterior Features

- Waterfront location with close relationship to the wharf
- Building partially extends over the water
- One-story volume with a cross-gable roof
- Dock at the west side of the sail loft portion of the building
- Wood walkway along the southwest edge of the building
- Mixture of wood shingle cladding and vertical wood cladding
- Original wood doors with an applied cross-brace pattern
- Large, gridded arrangements of fixed windows
- Evenly spaced window openings with the character of one-over-one double-hung window type along the south and west façades of the sail loft portion of the building
- Large opening for boat slips

Interior Features

- Two main volumes consisting of the sail loft and the transverse wing
- Organization of the transverse wing with its work platform, boat slips, and elevated rear storage aisle
- Original wood flooring throughout the building, including wood steps
- Original wood doors with applied cross-brace pattern (including the barn door between the sail loft and the transverse wing, and the door to the kitchen, originally the canvas locker)
- Wood railing and metal ladders between the elevated rear storage aisle and the boat slips[4]

PROPERTIES INELIGIBLE FOR THE NATIONAL REGISTER

One property, known as the Machine Shop (labeled as "15 – Shoreside Boiler, Workshop & Yard" in Appendix A's APE Map), is located within the Undertaking APE and was found to be age-eligible but ineligible for the National Register through evaluation. The structure was evaluated in April 2024 with DPR 523 A and B forms prepared by Page & Turnbull (attached as **Appendix C**). The one-story, metal-clad structure with a gable roof was installed within the Marine Yard in 1965 and originally served as a shoreside boiler house. At present, it serves as a machine shop and boiler house. The property has undergone several alterations, including changes to the configuration of openings,

[4] Page & Turnbull, *Cal Maritime Boathouse,* DPR 523 form, revised January 24, 2024, p. 16-17. Reproduced as **Appendix B.**

replacement doors, recladding and reroofing, and an addition. The building was found to not be eligible for either the National Register, California Register, or as a California State Historical Landmark (refer to **Appendix C**).

PROPERTIES NOT ELIGIBLE FOR EVALUATION

Five buildings and structures located within the Undertaking APE are younger than 50 years of age. These properties, which are not of the age at which architectural and landscape resources are typically eligible for listing in the National Register, are summarized in the following table. Properties or buildings for which a built date is not known were estimated following a review of historic aerial photographs. Buildings and structures with estimated year-built dates are marked with an * in the table below. Several additional metal containers and prefabricated structures are located within the boundaries of the Marine Yard but are moveable, non-permanent structures and are considered temporary.

NON-HISTORIC-AGED PROPERTIES WITHIN THE UNDERTAKING APE

Name	Year Built	Notes	Finding
Alumni Plaza	2008	Existing plaza near Simulation Center.	Not age eligible for evaluation.
Main Pier (including causeway)	1996	Replaced original 1942 pier.	Not age eligible for evaluation.
Marine Programs Building	ca. 2002*	Modular structure.	Not age eligible for evaluation.
Naval Sciences Building	ca. 1981*	Modular structure.	Not age eligible for evaluation.
Training Ship *Golden Bear III* (TSGB)	1996	Ship is only docked part of the year.	Not age eligible for evaluation.

SUMMARY OF ARCHITECTURAL PROPERTIES WITHIN THE UNDERTAKING APE

In summary, of the seven building and structures located within the Cal Maritime Waterfront Master Plan Undertaking APE, only one, the Cal Maritime Boathouse, is historic. The remaining six buildings and structures are not eligible for evaluation based on age or have been determined ineligible for listing in the National Register, as is the case with the Cal Maritime Machine Shop.

V. APPLICATION OF THE CRITERIA OF ADVERSE EFFECTS

Criteria of Adverse Effect

The criteria of adverse effect on historic properties under Section 106 of the NHPA are defined in 36 CFR § 800.5(a)(1):

> An adverse effect is found when an undertaking may alter, directly or indirectly, any of the characteristics of a historic property that qualify the property for inclusion in the National Register in a manner that would diminish the integrity of the property's location, design, setting, materials, workmanship, feeling, or association. Consideration shall be given to all qualifying characteristics of a historic property, including those that may have been identified subsequent to the original evaluation of the property's eligibility for the National Register. Adverse effects may include reasonably foreseeable effects caused by the undertaking that may occur later in time, be farther removed in distance or be cumulative.

According to 36 CFR § 800.5(a)(2), examples of adverse effects on historic properties include, but are not limited to:

- (i) Physical destruction of or damage to all or part of the property;
- (ii) Alteration of a property, including restoration, rehabilitation, repair, maintenance, stabilization, hazardous material remediation and provision of handicapped access, that is not consistent with the Secretary's Standards for the Treatment of Historic Properties (36 CFR Part 68) and applicable guidelines;
- (iii) Removal of the property from its historic location;
- (iv) Change of the character of the property's use or of physical features within the property's setting that contribute to its historic significance;
- (v) Introduction of visual, atmospheric, or audible elements that diminish the integrity of the property's significant historic features;
- (vi) Neglect of a property which causes its deterioration, except where such neglect and deterioration are recognized qualities of a property of religious and cultural significance to an Indian tribe or Native Hawaiian organization; and
- (vii)Transfer, lease, or sale of property out of federal ownership or control without adequate and legally enforceable restrictions or conditions to ensure long-term preservation of the property's historic significance (36 CFR Part 800.5(a) (2)).

To comply with Section 106, the criteria of adverse effect are applied to historic properties in the project's APE, pursuant to 36 CFR § 800.5 (a)(1). A finding of no adverse effect may be appropriate when the undertaking's effects do not meet the threshold set forth in the criteria of adverse effect, or in certain cases when the undertaking is modified to avoid or lessen effects, or conditions are imposed to ensure review of rehabilitation plans for conformance with the Secretary of the Interior's Standards for the Treatment of Historic Properties (codified in 36 CFR § 68). If adverse effects findings are made, mitigation is proposed and resolution of adverse effects occurs through consultation pursuant to 36 CFR § 800.6(a) to avoid, minimize, or mitigate adverse effects on historic properties.

Application of the Criterion of Adverse Effect: Cal Maritime Boathouse

The Boathouse, constructed in 1946, is the only historic property within the Undertaking APE. Proposed work that would directly alter the Boathouse would occur within Phase Two of the Undertaking.

The scope of work pertaining to the historic Boathouse building within the Cal Maritime Waterfront Master Plan Undertaking would include seismic upgrades to the building as well as foundation improvements and installation of new structural piles. Interior upgrades would include reverting the headhouse back to original use as sail loft, general ADA-compliant improvements, and restroom, electrical, and plumbing system upgrades. The Boathouse is partially located within Cal Maritime's Marine Yard, which lies adjacent to the Main Pier. The Marine Yard is currently used as a paved surface area for parking and provisioning training and contains various temporary modular storage units. As part of Phase Two of the Cal Maritime Waterfront Master Plan Undertaking, the Marine Yard would be expanded and converted to a pedestrian-oriented plaza with landscaping improvements and functional areas that would continue to serve staging, storage, and provisioning training purposes.

Per the adverse effects threshold detailed in CFR § 800.5(a)(2), an analysis of the Cal Maritime Waterfront Master Plan Undertaking pertaining to the historic Boathouse building finds the following:

Criterion I: Physical destruction of or damage to all or part of the property.

The historic Boathouse building located within the Cal Maritime Waterfront Master Plan Undertaking APE would neither be damaged nor destroyed.

Alterations to the Boathouse proposed by the Cal Maritime Waterfront Master Plan Undertaking would consist of seismic and foundation improvements, including the installation of new structural piles, that would increase its longevity and occupant safety. Proposed interior alterations would consist of ADA-compliant improvements throughout the building as well as upgrades to electrical and plumbing systems, ensuring the building's continued use within Cal Maritime's educational mission and practical needs for storage of the school's fleet of small vessels. Reversion of the Boathouse's headhouse to its original interior arrangement as a single open space used as a sail loft, returns the interior space to a functional work area for students, whereas currently it is subdivided with non-historic partitions into small rooms and offices.

The proposed Cal Maritime Waterfront Master Plan Undertaking would propose minor alterations to the Boathouse. As the Undertaking would neither damage nor destroy this historic property, it would not cause an adverse effect under this criterion.

Criterion II. Alteration of a property, including restoration, rehabilitation, repair, maintenance, stabilization, hazardous material remediation and provision of handicapped access, that is not consistent with the *Secretary's Standards for the Treatment of Historic Properties* (36 CFR Section 68) and applicable guidelines.

The following section includes an analysis of the Cal Maritime Waterfront Master Plan Undertaking under the *Secretary of the Interior's Standards*. The *Standards* are codified in 36 CFR 67 and address the most commonly used treatment for historic properties. Of the four approaches to treatment (preservation, restoration, rehabilitation, and reconstruction), rehabilitation allows the most change in the historic property. Rehabilitation encompasses projects that "mak[e] possible a compatible use for a property through repair, alterations, and additions while preserving those portions or features which convey its historical, cultural, or architectural values."[5]

> **Rehabilitation Standard 1:** *A property will be used for its historic purpose or be placed in a new use that requires minimal change to the defining characteristics of the building and its site and environment*.
>
> The Boathouse is significant for its associations with the early establishment of the California Maritime Academy campus in the 1940s (now known as Cal Maritime) and its continued use as an educational facility facilitating the hands-on teaching of small watercraft handling, maintenance and repair, and other maritime activities. As stated within the discussion of Criterion I, the Undertaking would consist of necessary accessibility and occupant safety improvements that would allow the Boathouse to sustain the long-term educational mission of Cal Maritime. The collective work that would be undertaken directly supports the continued historic purpose of the Boathouse and its immediate vicinity (e.g. the Marine Yard, Boat Basin, and waterfront), and would continue to facilitate hands-on maritime education for which the

[5] National Park Service. "Rehabilitation as a Treatment and Standards for Rehabilitation." National Park Service Technical Preservation Services, accessed February 28, 2023, https://www.nps.gov/articles/000/treatment-standards-rehabilitation.htm

Boathouse was first found significant. Other proposed changes of the Undertaking including the construction of the enlarged pier and the landscaping along the waterfront would not impact the historic purpose of the Boathouse and would also support the long-term mission of maritime education at the site. Therefore, the proposed Undertaking would be consistent with Standard 1.

Rehabilitation Standard 2: *The historic character of a property will be retained and preserved. The removal of distinctive materials or alteration of features and spaces that characterize a property shall be avoided.*

The historic character of the Boathouse would be retained and preserved to a high degree. No changes are proposed to the exterior of the building. Existing exterior openings (e.g., doors and windows) would not be altered or resized in any way. In instances where door and/or window components may require replacement, those replacements would be either in-kind or, if replacing non-historic materials, would install historically appropriate alternatives. The removal of the immediately adjacent temporary Marine Programs and Naval Science modular buildings would improve visibility of the Boathouse's north façade as viewed from the rest of the Cal Maritime campus.

Internally, work proposed by the Cal Maritime Waterfront Master Plan Undertaking would not remove or alter any distinctive materials, features, or spaces that characterize the interior of the historic Boathouse building. Proposed improvements and alterations would not alter its interior character-defining features, including its two primary volumes, the transverse wing with boat slips, original wood flooring, original wood doors with a cross-brace pattern, or wood railing and metal ladders between the elevated storage aisle and the boat slips.[6] Limited redesign and reconfiguration of the lower-level woodworking and vessel service/demonstration areas may be proposed; though overall, most of the interior spaces and their historic materials and features would be protected and preserved to maintain historic value and integrity. Installation of upgraded electrical and plumbing systems, as well as foundation and underwater support improvements would not affect the ability of the Boathouse to represent this significant context, as the building is, and would still be, used for essentially the same function.

Overall, the scope of work pertaining to the historic Boathouse building would retain its character as an L-shaped, one-story, wood-framed waterfront building partially constructed on land and overwater. The building would retain all of its character-defining features and the larger changes proposed by the Undertaking within Phases One and Three, would not alter the

[6] DPR 532L, Continuation Sheet, "Cal Maritime Boathouse," revised January 24, 2024. Refer to **Appendix B**.

historic character of the Boathouse, or change its relationship to the shoreline or the Cal Maritime campus. Therefore, the proposed Undertaking would be consistent with Standard 2.

Rehabilitation Standard 3: *Each property will be recognized as a physical record of its time, place, and use. Changes that create a false sense of historical development, such as adding conjectural features or elements from other buildings, shall not be undertaken*.

No conjectural features or architectural elements from other buildings are proposed to be added to the Boathouse or within the larger area of the Undertaking. The Boathouse would remain a physical record of its time, place, and use, and would continue to convey the features that make it significant as a place of maritime education. Other proposed changes that would be completed by the Undertaking, would be visually identifiable as contemporary alterations and would not include historicist elements or conjectural historic features. Therefore, the proposed Undertaking would be consistent with Standard 3.

Rehabilitation Standard 4: *Most properties change over time; those changes that have acquired historic significance in their own right shall be retained and preserved.*

There are no alterations to the Boathouse that have acquired historic significance in their own right. Alterations to the Boathouse that have occurred previously—including replacement exterior doors and windows, new openings with aluminum slider windows on the east façade of the transverse wing, installation of an in-wall air conditioning unit on the west façade, and the erection of non-historic interior partitions—have been relatively minor.

As no features or changes to the historic Boathouse undertaken since 1946 (the building's period of significance) have acquired significance in their own right, those features would not need to be retained or preserved and could be altered or removed during the course of the Undertaking. Therefore, the proposed Undertaking would be consistent with Standard 4.

Rehabilitation Standard 5: *Distinctive features, finishes, and construction techniques or examples of craftsmanship that characterize a property shall be preserved*.

The Boathouse is characterized by its L-shaped, one-story massing with low pitched cross-gable roof, mixture of wood-shingle and vertical wood-board cladding, large arrangements of gridded fixed windows, partial extension over the water of Morrow Cove, and boat slips and west dock. As discussed under Standard 2, the collective changes to the Boathouse as proposed by the Cal Maritime Waterfront Master Plan Undertaking would not impact the historic integrity of the building, as most proposed changes are unseen (e.g., mechanical and plumbing systems and seismic retrofits), and the resources would retain its distinctive materials, features, finishes, and construction techniques to a high degree with original craftsmanship remaining intact. Other proposed changes of the Undertaking in the vicinity of the Boathouse would not impact the distinctive features, finishes, and craftsmanship of the historic building. Therefore, the proposed Undertaking would be consistent with Standard 5.

Rehabilitation Standard 6: *Deteriorated historic features will be repaired rather than replaced. Where the severity of deterioration requires replacement of a distinctive feature, the new feature shall match the old in design, color, texture, and other visual qualities and, where possible, materials. Replacement of missing features shall be substantiated by documentary, physical, or pictorial evidence.*

To date, there are no known deteriorated historic features on the Boathouse that would require repair or replacement. If, following consultation with a preservation architect, historic features or materials are found to require replacement, those features would be replaced in-kind and would match the historic materials in design, texture, and color. In cases, where replacement or installation of seismic or tectonic supports require the removal of small sections of historic materials, those materials will be patched, repaired, or replaced in kind to match the historic material. Therefore, the proposed Undertaking would be consistent with Standard 6.

Rehabilitation Standard 7: *Chemical or physical treatments, such as sandblasting, that cause damage to historic materials shall not be used. The surface cleaning of structures, if appropriate, will be undertaken using the gentlest means possible.*

The Cal Maritime Waterfront Master Plan Undertaking does not propose any chemical or physical treatments to the Boathouse that would cause damage to its historic materials. The materials present at the Boathouse consist primarily of wood framing and cladding from the 1940s that is a physical reflection of the building's period of significance and, as such, would be treated with the gentlest means possible should it require cleaning or another treatment. Therefore, the proposed Undertaking would be consistent with Standard 7.

Rehabilitation Standard 8: *Significant archaeological resources affected by a project shall be protected and preserved. If such resources must be disturbed, mitigation measures shall be undertaken.*

The assessment of potential impacts to archaeological resources is being assessed by reports prepared by Far Western Anthropological Research Group and Natural Investigations Company. If archaeological resources are uncovered during any portion of the Undertaking, standard procedures would be implemented. Therefore, the proposed Undertaking would be consistent with Standard 8.

Rehabilitation Standard 9: *New additions, exterior alterations, or related new construction will not destroy historic materials that characterize the property. The new work shall be differentiated from the old and shall be compatible with the massing, size, scale, and architectural features to protect the historic integrity of the property and its environment.*

No additions or exterior alterations are proposed to the Boathouse by the Cal Maritime Waterfront Master Plan Undertaking. The alterations proposed would have little to no visual impact on the building and therefore would be compatible with the massing, size, and scale of the Boathouse. Related new construction, including the expansion of the Marine Yard and installation of a pedestrian-oriented plaza immediately adjacent to the Boathouse, would be utilitarian in their design and complement the historic Boathouse building.

Related new construction proposed by the Cal Maritime Waterfront Master Plan Undertaking include alterations to the Marine Yard, replacement and expansion of the Main Pier to support the new training ship, installation of new floating docks, berthing areas, and gangways within the boat basin, establishment of the Boathouse Forecourt as a new gathering space, and landscaping and waterfront improvement measures along the shoreline. The proposed alterations of the Undertaking would not destroy or remove historic features of the Boathouse, and are deferential and compatible in their scale, size, and features. The Boathouse would retain its historic form, massing, materials, and location, and the relationship of the Boathouse to the shoreline and the Cal Maritime campus would be preserved. Related nearby construction is intended to be utilitarian or contemporary in design and deferential to the overall waterfront character of the Cal Maritime campus. All new work in the vicinity of the Boathouse would be easily differentiated from the historic building, while maintaining compatibility with the Boathouse's massing, size, scale, and architectural features. Therefore, the proposed Undertaking would be consistent with Standard 9.

Rehabilitation Standard 10: *New additions and adjacent or related new construction shall be undertaken in such a manner that, if removed in the future, the essential form and integrity of the historic property and its environment would be unimpaired*.

Alterations to the Boathouse proposed by the Cal Maritime Waterfront Master Plan Undertaking have been designed to be minimally impactful to the building's exterior walls and roofing. Seismic upgrades and tectonic modifications of the existing structure, including foundation improvements and the installation of new structural piles (both below ground and underwater) would be tied into the structure at strategic locations with minimal to no visible impact. If these features were altered or removed in the future, the Boathouse would retain its essential form and integrity.

If adjacent related new construction in the Marine Yard, inclusive of the existing pedestrian-oriented plaza adjacent to the Simulation Center Plaza as well as the proposed Boathouse Forecourt area, were to be removed in the future, the essential form and integrity of the Boathouse would also be retained. The same would also apply to the expanded and elevated Main Pier, floating docks, and berthing areas proposed south of the Boathouse, as well as those proposed to the northwest that would create a second boat basin for the campus. Other adjacent improvements related to shoreline enhancements, such as the installation of pedestrian paths and plantings along the waterfront, and the establishment of a waterfront plaza, public pier and lookout deck with a shade structure, fire pit, and other furnishings, are also proposed along the shoreline, but would not alter the relationship of the Boathouse to the shoreline. Should any of these shoreline enhancement elements be removed in the future, the essential form, integrity, location, and setting of the historic Boathouse building would be unimpaired.

As the Boathouse and its immediate vicinity within the direct area of work of the Undertaking would retain its original form and historic integrity, the integrity and significance of the building would also be retained. Therefore, the proposed Undertaking would be consistent with Standard 10.

Summary of Analysis under Criterion II

The proposed undertaking would be consistent with all ten of the *Secretary of the Interior's Standards for Rehabilitation*, and therefore the Cal Maritime Waterfront Master Plan Undertaking would not cause an adverse effect to the historic Boathouse building under this criterion.

Criterion III. Removal of the property from its historic location.

The work proposed by the Cal Maritime Waterfront Master Plan Undertaking would not involve the removal of the historic resource from its historic location. Therefore, it would not cause an adverse effect to the historic Boathouse under this criterion.

Criterion IV. Change of the character of the property's use or of physical features within the property's setting that contribute to its historic significance.

As discussed above with respect to the *Secretary of the Interior's Standards for Rehabilitation* under Standard 1, the proposed use of the Boathouse would be consistent with its historical purpose. It would continue to be used for its historic purpose of conducting educational and hands-on training activities in waterfront and maritime operations.

In addition, the retention of historic features and the historic character of the historic resource was discussed above under Standards 2 and 5 of the *Secretary of the Interior's Standards for Rehabilitation*. This discussion states that the Boathouse is most significant for its function, historic association with the Cal Maritime waterfront and maritime curriculum since 1946, and its overall character as interconnected with the campus' waterfront and fleet of small vessels. The massing and form of the Boathouse would not be impacted through the alterations proposed by the Cal Maritime Waterfront Master Plan Undertaking, which is limited to the foundation, specific interior spaces, and electrical and plumbing systems. The Boathouse would retain its historic connection, historic form, and historic integrity.

Proposed alterations to the Boathouse's surrounding landscape, including the expansion and conversion of the Marine Yard to a pedestrian-oriented plaza under the Cal Maritime Waterfront Master Plan Undertaking, would not impact the setting of the historic resource as the southern section of the Cal Maritime has relatively flat topography and is closely associated with the waterfront. Therefore, the Cal Maritime Waterfront Master Plan Undertakings would not cause an adverse effect to the historic Boathouse under this criterion.

Criterion V. Introduction of visual, atmospheric, or audible elements that diminish the integrity of the property's significant historic features.

The proposed Cal Maritime Waterfront Master Plan Undertaking would result in minor alterations to the appearance of the Boathouse that would not diminish the integrity of its significant and character-defining features. Additional alterations that are adjacent to the Boathouse, including the expansion and conversion of the Marine Yard to a pedestrian-oriented plaza, are also consistent with previous alterations to the site, are utilitarian in their design, and do not touch historic materials. The length, massing, and size of the Boathouse and its relationship to the Marine Yard and broader waterfront of the Cal Maritime campus is intended to remain visually apparent, such that the proposed Undertaking would not diminish the integrity of the historic resource. Atmospheric, visual, and audible elements to be introduced by the proposed Cal Maritime Waterfront Master Plan Undertaking would be temporary, occurring only during the construction phase of the project; these temporary visual and audible elements would have no lasting effect on the integrity of the historic resource.

Therefore, the Cal Maritime Waterfront Master Plan Undertaking would not cause an adverse effect to the historic Boathouse under this criterion.

Criterion VI. Neglect of a property which causes its deterioration, except where such neglect and deterioration are recognized qualities of a property of religious and cultural significance to an Indian tribe or Native Hawaiian organization.

The Cal Maritime Waterfront Master Plan Undertaking would collectively facilitate the continued use of the Boathouse for specialized waterfront and maritime training in water safety, shipboard maintenance, operations, management, and small boat handling. The Undertaking would not involve the neglect of any property within the APE that causes its deterioration. The Boathouse is not currently neglected nor in a deteriorated state. As no substantial changes are proposed for this historic resource by the Cal Maritime Waterfront Master Plan Undertaking, the Boathouse would not be adversely affected under Criterion VI. Therefore, the Cal Maritime Waterfront Master Plan Undertaking would not cause an adverse effect to the historic resource under this criterion.

Criterion VII. Transfer, lease, or sale of property out of Federal ownership or control without adequate and legally enforceable restrictions or conditions to ensure long-term preservation of the property's historic significance.

The Cal Maritime Waterfront Master Plan Undertaking would not involve the transfer, lease, or sale of property out of Federal ownership or control, and therefore, would not cause an adverse effect to the historic Boathouse under this criterion.

Finding of No Adverse Effect

The proposed Cal Maritime Waterfront Master Plan Undertaking complies with the *Secretary of the Interior's Standards for Rehabilitation*. The Undertaking would not cause adverse impacts to the historic Boathouse. Furthermore, the Cal Maritime Waterfront Master Plan Undertaking does not involve any changes that are listed as examples of potential adverse effects provided in CFR § 800.5(a)(2). The proposed improvements to the Boathouse to be undertaken by the Cal Maritime Waterfront Master Plan Undertaking, would comply with the criteria of potential adverse effects in 36 CFR § 800.5(a)(1) because they would not alter those character-defining features that qualify the historic resource for inclusion in the National Register.

Based on review of the Cal Maritime Waterfront Master Plan Undertaking as applicable to the historic Boathouse building, this analysis has resulted in a finding of **no adverse effect** [36 CFR § 800.5(b)].

VI. REFERENCES

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Natural Investigations Company. *Cultural Resources Assessment for the California State University Maritime Academy Waterfront Master Plan, Solano County, California.* January 2023.

Page & Turnbull. DPR 523 A, B, and L Forms, "Cal Maritime Boathouse," 2022, revised January 24, 2024.

VII. APPENDICES

- **Appendix A**: Location map and APE map for the Cal Maritime Waterfront Master Plan Undertaking.
- **Appendix B**: DPR 523 forms for *Cal Maritime Boathouse*, which were prepared for the *Cal Maritime Boathouse Historic Resource Evaluation* (2022, revised 2024).
- **Appendix C:** DPR 523 forms for *Cal Maritime Machine Shop* (2024).

APPENDIX A

Location map and APE map for the Cal Maritime Waterfront Master Plan Undertaking.

Undertaking Location

0 0.5 1 Kilometers

0 0.5 1 Miles

1:24,000

California Maritime
Location Map

NATURAL INVESTIGATIONS COMPANY

Map Date 9/1/2022

Benicia 1959 Quadrangle Photorevised 1980: Township 3N, Range 3W, Unsectioned

Source: Adapted by Ascent in 2022. Revised by Page & Turnbull in 2024.


1 Dining Center
2 Mayo Hall - Old Gym/Pool
3 Rizza Auditorium
4 Administration
5 STEAM Plant Simulator
6 Simulation Center
7 Marine Programs Building
8 Naval Sciences Building
9 Alumni Plaza
10 Seamanship Building (Boathouse)
11 Marine Yard
12 TSGB
13 Boat Basin
14 Pier
15 Shoreside Boiler, Workshop & Yard
16 Trestle or Causeway
APE MAP - Cal Maritime Waterfront Master Plan Undertaking
0 100 200 Feet

APPENDIX B

DPR 523 forms for *Cal Maritime Boathouse*, which were prepared for the *Cal Maritime Boathouse Historic Resource Evaluation* (2022, revised 2024).

State of California — The Resources Agency
DEPARTMENT OF PARKS AND RECREATION

PRIMARY RECORD

Primary #
HRI #
Trinomial
NRHP Status Code
Other Listings
Review Code **Reviewer** **Date**

 Resource name(s) or number (assigned by recorder) Cal Maritime Boathouse

P1. Other Identifier:
***P2. Location:** ☐Not for Publication ☒Unrestricted ***a. County** Solano
***b. USGS 7.5' Quad** Benicia, CA **Date** 2018
***c. Address** 200 Maritime Academy Drive **City** Vallejo **Zip** 94590
d. UTM: (Give more than one for large and/or linear resources) Zone ______ mE/ ______ mN
***e. Other Locational Data:** Assessor's Parcel Number 0062-090-030

***P3a. Description:** (Describe resource and its major elements. Include design, materials, condition, alterations, size, setting, and boundaries.)
The Cal Maritime Boathouse was completed in 1946 and was designed in a utilitarian style by the California Department of Public Works, Division of Architecture, as one of the first permanent buildings of the new California Maritime Academy campus. The Boathouse is located along Morrow Cove near the Carquinez Strait at the south end of the Cal Maritime campus **(Figure 1)**. Historically, the building was also called the Seamanship Building. In 1989, the building was dedicated in honor of Edwin C. Miller, a past graduate of and teacher at the Maritime Academy and was renamed the Edwin C. Miller Seamanship Center.

The Boathouse has been in use as an educational building since its construction. It serves the Cal Maritime campus by storing the school's smaller boats; providing a location for maintenance and storage of small watercraft, sails, rigging, and tools; and includes small offices for staff and a workshop. The Boathouse also has a close connection to the waterfront and the adjacent wharf where Cal Maritime's Training Ship (currently the *T.S. Golden Bear III*) is regularly docked.

The building is not aligned to the cardinal directions, but for the ease and clarity of the building description, the façade that faces the bay and the wharf will be described as the west façade, the façade with the primary entrance will be described as the south façade, and so on. (Refer to Continuation Sheet, page 2.)

***P3b. Resource Attributes:** HP15. Educational building; HP39. Other
***P4. Resources Present:** ☒Building ☐Structure ☐Object ☐Site ☐District ☐Element of District ☐Other

P5a. Photo

P5b. Photo: (view and date)
Boathouse viewed from adjacent pier, looking northeast, September 18, 2021.

***P6. Date Constructed/Age and Sources:** ☒Historic ☐Prehistoric ☐Both
1945-46. Original drawings, December 1945.

***P7. Owner and Address:**
California State University Maritime Academy
200 Maritime Academy Drive
Vallejo, CA 94590

***P8. Recorded by:**
Barrett Reiter, Maggie Nicholson
Page & Turnbull, Inc.
170 Maiden Lane, 5th Floor
San Francisco, CA 94108

***P9. Date Recorded:**
January 5, 2022

***P10. Survey Type:** Intensive

***P11. Report Citation:** None

***Attachments:** ☐None ☐Location Map ☐Sketch Map ☒Continuation Sheet ☒Building, Structure, and Object Record ☐Archaeological Record ☐District Record ☐Linear Feature Record ☐Milling Station Record ☐Rock Art Record ☐Artifact Record ☐Photograph Record ☐ Other (list)

***P3a. Description (Continued)**

Figure 1: Boathouse at the Cal Maritime Academy campus. Building identified with dashed red line. Source: Google Maps, 2021. Edited by Page & Turnbull.

The Boathouse is L-shaped in plan, with the primary entrance located along the south end of the building which sits on land, while the north end of the building projects over the water of Morrow Cove to allow for boat slips along the north end of the west façade. The building's foundation consists of wood piles on concrete footings; it is clad in a combination of painted wood shingles and painted vertical wood siding and has an asphalt shingle-clad cross-gable roof. The overall style of the building is utilitarian with decorative elements limited to the cross-brace pattern applied to the building's original wood doors.

The base of the building's L-shaped plan contains the primary entrance and "sail loft," where historically sails were cut, sewn, and repaired, beneath a steeply pitched side-gable roof. This section of the building is clad in painted wood shingles. The remaining length of the building, which will be referred to as the transverse wing, is clad in vertical painted wood siding and has a lower pitched roof. This area contains a work platform, boat slips, and some areas for storage and tooling.

Primary (South) Façade

The south façade contains the main entrance to the building and faces a small paved parking area located immediately north of the dock. The original entrance door consists of a painted wood door with an applied cross brace pattern. It is located at the west (left) end of the south façade but is currently not in use and blocked with a bench at the exterior **(Figure 2 and Figure 3)**. A small shed roof extends from the primary roof form over this entrance and has a wood paneled soffit with a ceiling-mounted light. To the west (left) of the entrance door, a wood staircase with a wood railing descends to a small wood walkway and dock along the west façade that extends over the water.

The remaining openings of the south façade consist of a single one-over-one vinyl replacement window to the east (right) of the original entrance door, a single leaf wood door that is currently used as the primary entrance door, and three evenly spaced one-over-one vinyl replacement windows **(Figure 4)**. A decorative dedication plaque is mounted to the east (right) of the current primary entrance door that reads "Edward C. Miller Seamanship Building." A wood sign over the entrance reads "Boat House."

Figure 2: South façade of the Boathouse, looking northeast.

Figure 3: South façade of the Boathouse, looking northwest.

Figure 4: Detail of east portion of the south façade. Looking northeast.

East Façade

The east façade of the sail loft portion of the Boathouse has a louvered vent centered within its gable peak and openings at the ground floor consist of two non-original partially glazed wood doors and two non-original, double-hung, one-over-one vinyl windows **(Figure 5 and Figure 6)**.

The transverse wing of the Boathouse has a single-leaf wood door within a recessed opening near its south end, a wood utility door with an applied cross-brace pattern to the north of the door, and four evenly spaced non-original aluminum slider windows along the remaining length of the building **(Figure 7 and Figure 8)**.

Figure 5: Detail of doors at east façade of the sail loft portion of Boathouse, looking south.

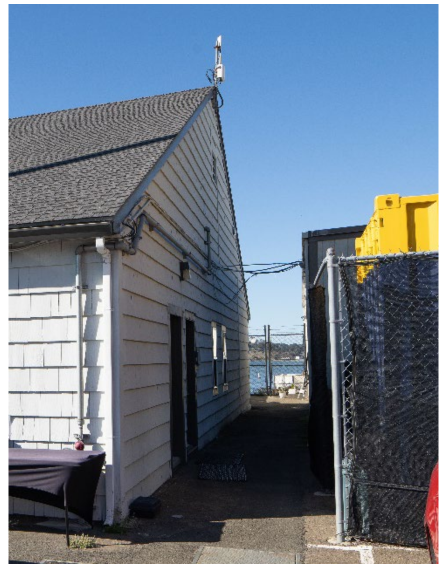


Figure 6: Oblique view of east façade of the sail loft portion of the Boathouse. Looking southwest.

Figure 7: South end of the east façade of the transverse wing of the Boathouse, looking west.

Figure 8: East façade of the transverse wing of the Boathouse. Looking slightly southwest.

North Façade

The north-facing wall of the sail loft portion of the building has a single one-over-one vinyl replacement window **(Figure 9)**. The north façade of the transverse wing features a one-over-one vinyl replacement window at its east (left) side and a gridded window arrangement of fixed glazing that is three panels wide and four panels tall with painted wood mullions **(Figure 10)**.

Figure 9: North-facing wall of sail loft portion of Boathouse. Looking slightly southwest.

Figure 10: North façade of Boathouse, looking southwest.

West Façade

The west façade of the Boathouse along the transverse wing is open to the wharf and Morrow Cove for approximately half of its length to accommodate a number of boat slips **(Figure 11)**. The corners of this wide opening are clipped, and wood posts are visible that separate the boat slips and support the interior structure. The Cal Maritime logo and lettering reading "CAL MARITIME" is centered over this opening. To the south (right) of the opening for the boat slips is a large gridded window arrangement of eight windows wide and three windows tall with painted wood mullions.

The west façade of the sail loft of the Boathouse has a louvered vent centered within its gable peak and three evenly spaced one-over-one vinyl replacement windows **(Figure 12)**. A wall-mounted air conditioning unit is located near the south (right) corner of the west façade.

Figure 11: West façade of the Boathouse as seen from the Cal Maritime dock, looking east.

Figure 12: West façade of sail loft portion of the Boathouse. Looking slightly northeast.

Interior of Boathouse

As mentioned previously, the Boathouse consists of a sail loft, where historically sails were cut, sewn and repaired, and a transverse wing that contains the boat slips, work platform, and storage aisle **(Figure 13)**. The interior of the sail loft portion of the Boathouse has been divided into a number of small rooms including offices, workspaces, storage, and a kitchen **(Figure 14 to Figure 17)**. Some original wood doors with applied cross braces are extant, including the door between the sail loft and the work platform and the door to the kitchen **(Figure 16 and Figure 17)**. Floors consist primarily of wood, but some areas within the sail loft portion of the building have applied linoleum tiles, including the kitchen, entrance lobby, some offices, and the bathroom. Lighting throughout the building consists of non-original, ceiling-mounted, fluorescent lighting. The kitchen and some offices along the midpoint of the building have drop ceilings.

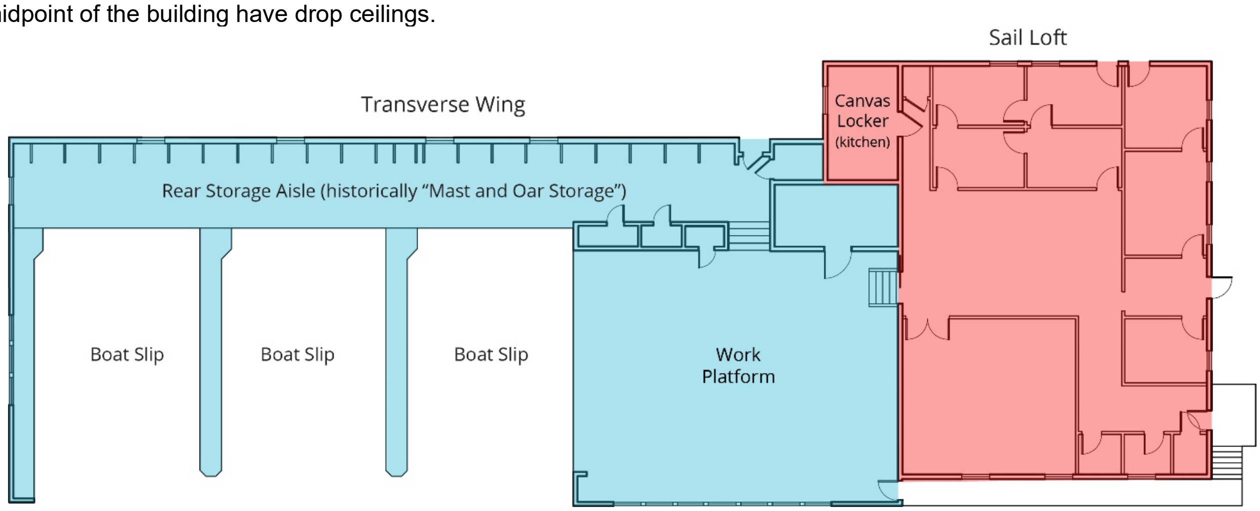


Figure 13: Floor plan of Boathouse, with transverse wing shaded blue and the sail loft including the canvas locker (now the kitchen) shaded red. Source: Page & Turnbull, based on original 1945 floorplan and measurements of existing partitions.

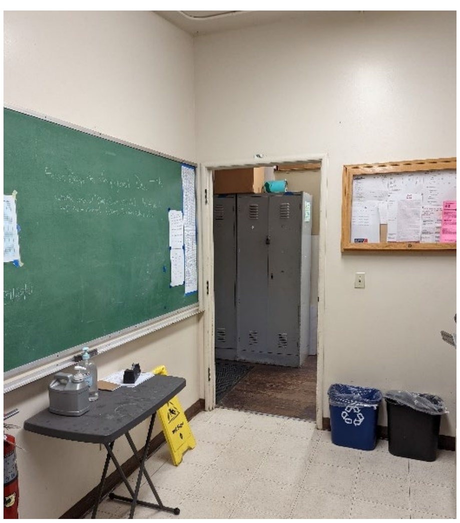


Figure 14: Looking slightly northwest from within the sail loft portion of the Boathouse.

Figure 15: Original door extant in sail loft portion of Boathouse.

Figure 16: Looking slightly northwest from within the sail loft portion of the Boathouse.

Figure 17: Original door extant in sail loft portion of Boathouse.

The transverse wing is divided into three areas including the boat slips, which fill the majority of the north end of the wing and are open to the exterior; a work platform that is positioned behind the windows of the west façade and connects to the sail loft with a small flight of wood steps and an original wood door with applied cross bracing; and an elevated aisle along the east wall of the wing that is labeled as mast and oar storage on the original plans and used for general storage of rope, lifejackets, masts, oars, and other related material **(Figure 18, Figure 19, and Figure 20)**.

Figure 18: Looking north at the boat slips from the work platform. Note the yellow painted metal ladders from the rear storage area.

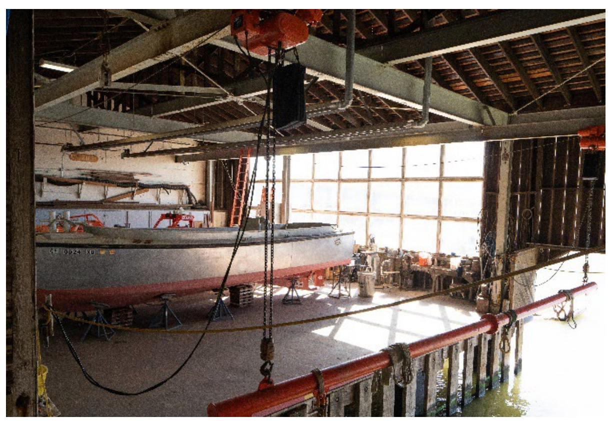


Figure 19: The work platform, as viewed from the elevated rear storage area, overlooking the south end of the boat slips. Looking southwest.

Figure 20: Looking south into the sail loft from the work platform.

Figure 21: Looking northeast from the work platform to the elevated storage area.

This elevated aisle is reached by wood stairs from the work platform and overlooks the boat slips **(Figure 21)**. A wood railing separates the elevated storage area from the boat slips, and small metal ladders along its west side provide access to the boat slips **(Figure 22)**. An enclosed section at the south end of the rear storage area houses a restroom and storage areas **(Figure 23)**. A notable feature of the transverse wing of the Boathouse is the exposed steel frame that supports the wood framed roof and connects to the foundation piers at key locations **(Figure 24)**.


Figure 22: Looking north along the elevated rear storage area.

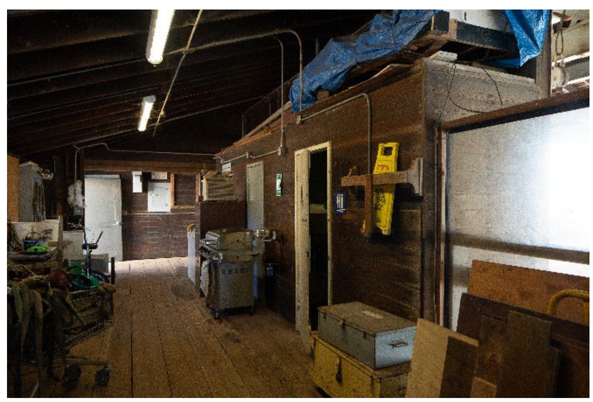


Figure 23: Looking south along the elevated rear storage area.


Figure 24: Looking southwest and up at metal framing of building.

Related Site Features

The Boathouse is located at the southern end of the Cal Maritime campus, and it is closely associated with the pier that has been present at this location since the early 1940s. The existing pier was constructed in 1995-1997, replacing a 1940s wood wharf, and features a concrete deck with timber piers, a steel frame structure, and a steel sheet pile breakwater.[1]

A number of temporary buildings, sheds, and utility structures have been erected in the area of the Boathouse since its construction in 1946 **(Figure 25)**. This area, including the parking lot at the southeast end of the Boathouse, is currently blocked off with a metal fence and security station.

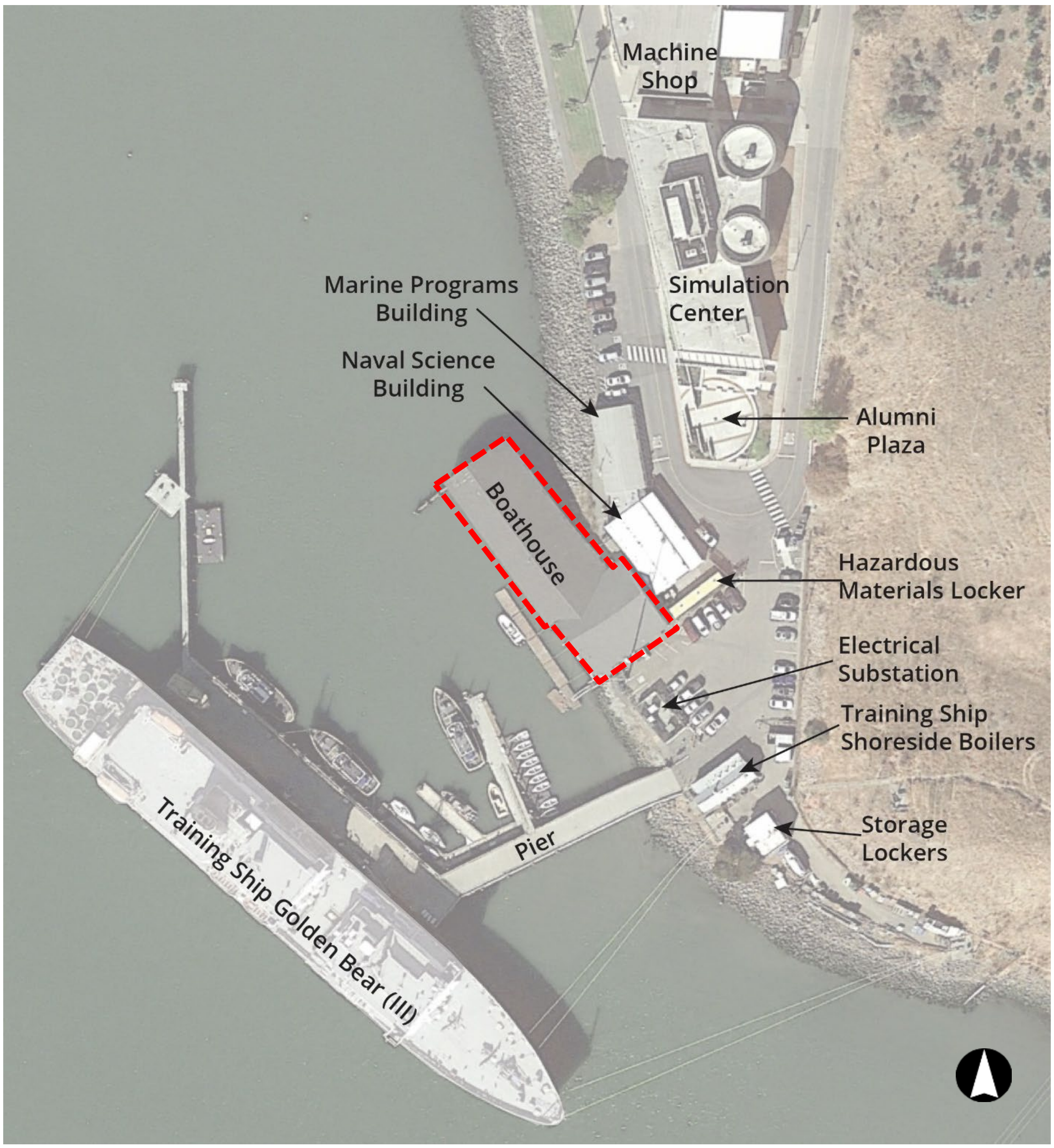


Figure 25: Buildings and structures located around the Boathouse (outlined with dashed red line). Source: Page & Turnbull. Base map: Google Earth aerial photograph, 2021.

[1] Refer to "California Maritime Academy: Pier Extension" drawings, dated June 28, 1995.

BUILDING, STRUCTURE, AND OBJECT RECORD

***NRHP Status Code** 3S, 3CS

***Resource Name or #** Cal Maritime Boathouse

B1. Historic name:

B2. Common name: Cal Maritime Boathouse

B3. Original Use: Educational/Maritime

B4. Present use: Educational/Maritime

***B5. Architectural Style:** Utilitarian

***B6. Construction History:** (Construction date, alterations, and date of alterations)

Development of Morrow Cove as the Cal Maritime Campus

Morrow Cove was one of the many sites that was visited during the search for a new campus for the California Maritime Academy in the early 1940s. In December 1940, a survey party of administrators from Cal Maritime visited Morrow Cove, which had some piers, structures, and the remnants of the *Bangor* sailing schooner and the *Contra Costa* ferryboat **(Figure 18)**. (Continued on page 11.)

***B7. Moved?** ☒No ☐Yes ☐Unknown **Date:** ____ **Original Location:** ____

***B8. Related Features:** None

B9a. Architect: California Department of Public Works, Division of Architecture b. Builder: unknown

***B10. Significance: Theme** Establishment of Cal Maritime Campus **Area** Vallejo

Period of Significance 1946 **Property Type** Boathouse **Applicable Criteria** A/1 (Events)

Historic Context:

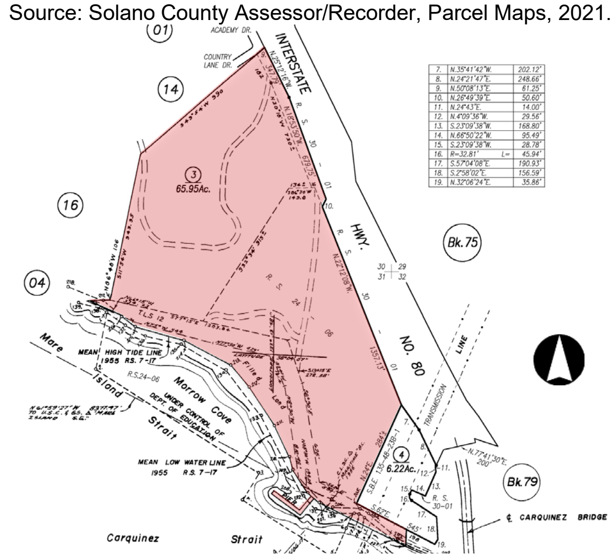
Brief History of Morrow Cove Prior to 1940

Located at the mouth of the Carquinez Straight, Morrow Cove is now the southernmost tip of Vallejo, but until the construction of the Carquinez Bridge in 1927 this area remained remote from the growing city of Vallejo.

The following brief history of Morrow Cove is summarized from several sources including *A Brief History: The California Maritime Academy Historical Archives* written by archivist Doug Peterson for the 75th anniversary of the school, the Historic American Engineering Record (HAER) report on the Carquinez Bridge, historical newspaper articles, and various articles on the history of the campus that were included in *Hawsepipe,* the yearbook of Cal Maritime.[2]

Prior to the construction of the Carquinez Bridge in 1927, several ferries and automobile ferries operated along the Strait in order to allow navigation from Vallejo to the East Bay. Early automobile ferries that operated along the Strait include the Martinez-Benicia Ferry & Transportation Company in 1913, the Rodeo-Vallejo Ferry Company in 1918, and the Six-Minute Ferry in 1919, which operated between Morrow Cove and the town of Crockett.[3] Unfortunately, the Six-Minute Ferry's terminal at Morrow Cove was destroyed by a landslide in 1922. The Rodeo-Vallejo Ferry Company acquired the holdings of the Six-Minute Ferry and expanded its ferry business, which transported over one million passengers annually in approximately 400,000 vehicles in 1923 and 1924 **(Figure 16)**.[4] (Continued on page 12.)

Source: Solano County Assessor/Recorder, Parcel Maps, 2021.



B11. Additional Resource Attributes: N/A

***B12. References:** See footnotes and bibliography, page 19.

B13. Remarks: N/A

***B14. Evaluator:** Barrett Reiter and Maggie Nicholson, Page & Turnbull, Inc.

***Date of Evaluation:** January 5, 2022, revised January 24, 2024

(This space reserved for official comments.)

[2] Doug Peterson, *A Brief History: The California Maritime Academy Historical Archives,* CSU Maritime (website), Accessed September 21, 2021, https://www.csum.edu/about/media/cal-maritime-history-75th-anniversary.pdf; National Park Service, *Carquinez Bridge,* Historic American Engineering Record (HAER No. CA-297).

[3] George H. Harlan, *San Francisco Bay Ferryboats,* (Berkeley: Howell-North Books, 1967), 17.

[4] Charles Derleth. "Cantilever Highway Bridge Across Carquinez Strait." *Engineering News-Record*, September 24,1925, 504.

***B6. Construction History (continued):**

Development of Morrow Cove as the Cal Maritime Campus (continued)

As early as 1941, the 67-acre area along the shore of Morrow Cove was approved as the location of the new California Maritime Academy campus; but acquiring funding and navigating the political situation during World War II delayed the school's occupation of the site.[5] While piles were driven for a new pier as early as 1941, the site was not suitably completed for occupation by the school until August 1943 **(Figure 29)**. At this time, the Training Ship (T.S.) Golden State was able to dock at the new wharf, and several temporary buildings provided facilities for students and teachers.[6] The site was developed in earnest in 1943 while the land was cleared, leveled, and graded and 330,000 cubic yards of earth were relocated from higher on the site to fill in a portion of the Cove.[7] At this time, the remnants of the hull of the *Bangor* were buried in the area that was infilled. Attempts to remove the hull of the *Contra Costa*, including refloating, towing, dredging, and dynamiting, all failed and elements of the hull remain extant and can be seen at low tide.[8] This process of infill extended the shoreline westward into the bay and created 12 additional acres of flat land along the shore.[9] Permanent structures were then added through phased construction.

The construction program to erect permanent buildings on the campus was announced in early 1944 and started in September 1945 with the laying of a cornerstone for the gymnasium (now called Mayo Hall).[10] This permanent building plan followed the guidance of a Master Development Plan developed by the California Department of Public Works, Division of Architecture, that proposed a symmetrical arrangement of buildings and pavilions that flanked a central Drill Field located along the shoreline **(Figure 30)**. The Master Plan showed a "Boat Shed" at the location of – and with a similar footprint to – the sail loft portion of the existing Boathouse; a separate Sail Loft building was proposed to be located north of the Boat Shed. The Master Development Plan appears to have helped guide the placement of some of the early facilities of the campus. However, the Boathouse – as it was constructed with its L-shaped footprint – did not adhere to the Master Development Plan. It was designed in 1945 and completed in 1946.[11]

When completed, the Boathouse was used for "instruction in manila and wire splicing, canvas work, boat overhaul, and the reeving of blocks and tackles."[12] The campus remained relatively open along its southern end until the erection of Dwyer Hall, which was completed in 1960 and was the first large campus building located near the Boathouse **(Figure 31)**. Since that time, a number of new buildings have been erected at the campus, including the replacement of Dwyer Hall. Today, two modular buildings have been erected just east of the Boathouse – for Marine Programs and Naval Science – and the Simulation Center and the Steam Plant Simulator are located just north of that.[13]

Construction of the Boathouse

Due to the ownership of the campus by the California State University system, building permits are not on file with the City of Vallejo. Beyond the original drawings of the Boathouse, the staff at Cal Maritime was unable to locate permits or drawings in their records that depicted alterations.

The Boathouse, as it appears today, is largely unaltered from its original form and design at the exterior as illustrated by the 1945 drawings by the Department of Public Works, Division of Architecture and from mid- and late 1940s photographs **(Figure 32, Figure 33, and Figure 34)**. Along the interior, alterations have been made primarily to the south end of the building within the area historically called the sail loft. Alterations to the exterior and the interior are listed below.

The following list of exterior alterations have occurred since the Boathouse was completed in 1946; alterations have been established through visual comparison between the original drawings from 1945, available historic photographs, and the Boathouse today.

- Reroofed at an unknown date, replacing the original wood-shingle roof
- Doors and windows installed along east façade of the sail loft portion of building after 1971 **(Figure 35)**

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[5] Confusion around the federal agencies involved in the administration of the Merchant Marine was one of the factors that caused additional delay as Cal Maritime's campus project was placed under the jurisdiction of the Coast Guard and then subsequently reverted to the War Shipping Administration through an executive order by President Roosevelt. "Work Ordered on Maritime School at Morrow Cove," *Long Beach Sun,* July 10, 1942.
[6] The last temporary building from the early 1940s was removed in 1979. Refer to "1940s,"*Hawsepipe,* 1993, 51.
[7] "Sea Academy Contract is Let, *The Sacramento Bee,* November 4, 1943. This contract was let to A. Teichert & Company of Sacramento.; For number of yards of earth moved refer to: "The Interim Years: 1940-1943," *Hawsepipe,* 1963, 254.
[8] Peterson, unpublished manuscript on file at the Campus History Center.
[9] "The Interim Years: 1940-1943," *Hawsepipe,* 1963, 254.
[10] "Maritime Academy Expansion Planned," *Oakland Tribune,* February 15, 1944, 11.; "California Maritime Academy," *Pacific Marine Review,* October 1945, 579.
[11] Refer to 1945 drawings of the Boathouse and Wharf. Supplied to the author by the administration of CSU Maritime.
[12] Committee on Efficiency and Cost Control, *The California Maritime Academy: Report of the Committee on Efficiency and Cost Control*, April 26, 1971, 4.
[13] LSA, *California State Maritime Academy, Physical Master Plan, Final Environmental Impact Report,* May 2018. Existing Facilities, Figure 3-3.

- Door installed at primary (south) façade between 1976 and 1989 **(Figure 36 and Figure 37)**
- Small aluminum slider windows installed at east façade of transverse wing at an unknown date[14]
- Edwin C. Miller dedication plaque installed circa 1989[15]
- Original one-over-one double-hung wood windows replaced with vinyl windows at all locations since 2008 **(Figure 38)**
- Fixed glazing of large window arrangements at west and north façades replaced in kind at an unknown date

The following list of interior alterations relates primarily to the sail loft portion of the Boathouse. All alterations were identified through visual observation of the existing conditions of the Boathouse's interior and a comparison with the original 1945 drawings of the building.

- Erection of several interior partitions within the sail loft for offices, an entrance vestibule, machine shop, storage areas, and restroom
- Installation of linoleum flooring in some offices
- Installation of drop ceilings in some offices along the east of the sail loft
- Installation of ceiling-mounted fluorescent lighting

Overall, the Boathouse remains largely unaltered in its original materials, form, use, and location.

***B10. Significance:**
<u>Historic Context (continued)</u>
<u>Brief History of Morrow Cove Prior to 1940 (continued)</u>
The automobile ferry business was highly successful, but many drivers still chose to take the land route, consisting of an additional 30 miles, to avoid waiting for the ferry which struggled to meet the demand. Therefore, the owners of the Rodeo-Vallejo Ferry Company began to plan for the construction of a toll bridge to cross the Carquinez Strait and formed the American Toll Bridge Company. When the Carquinez Bridge opened in 1927, with its two main spans of 1,100 feet each, it had the second longest cantilever spans in the country and the fourth longest in the world.[16] In addition to its status as an engineering marvel, when completed, the Carquinez Bridge shortened the route from Sacramento to the Bay Area and was integrated into the transcontinental Lincoln Highway.

In the late 1920s, it appears that Morrow Cove had already become popular as a local fishing spot for bass, which feed in the area. By the early 1930s, the American Toll Bridge Company (who developed the Carquinez Bridge) sought to expand the appeal of the area and create a popular recreation area that would serve the citizens of Vallejo, the residents of the larger Bay Area who could now easily reach Morrow Cove for a day of leisure, and the tourists moving along the Lincoln Highway route. In 1933, the American Toll Bridge Company undertook a number of improvements including landscaping the Cove and installing a dance platform, playgrounds, picnic areas, and bathing facilities **(Figure 27)**.[17] Fishing clubs sprung up along the shoreline, and the cove even had a small café to provide refreshments. Enhancing the swimming area was a significant man-made breakwater, in the form of two abandoned ships: the *Bangor,* a sailing schooner, and the *Contra Costa,* a ferryboat that transported railcars.[18]

At the beginning of U.S. involvement in World War II in December 1941, the California Department of Public Works issued an order to restrict access to Morrow Cove due to its proximity to the base of the Carquinez Bridge, which was seen as a strategic link between the "lower bay region and the Vallejo-Mare Island defense area."[19] This protective measure against possible sabotage of the bridge closed Morrow Cove to swimmers and fishermen in the 1940s. It is likely that public access to Morrow Cove remained restricted throughout World War II and allowed for this area to be considered as a possible location for the future Cal Maritime campus.

<u>History of Cal Maritime</u>
The following brief history of the early establishment of Cal Maritime, originally called the California Nautical School, has been excerpted from the 1979 volume of *Hawsepipe,* on the 50th Anniversary of the school.[20]

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[14] A c. 1960s photograph in the collection of the CSU Maritime Campus History Collection offers a rare view of this rear façade and shows that no windows were present at that date. Refer to **Supplementary Materials** (beginning at page 19).
[15] Refer to *Hawsepipe*, 1989 or *Pacific Northwest News*, November 2009. Both sources describe the dedication of the Boathouse to Edwin C. Miller.
[16] National Park Service, *Carquinez Bridge,* HAER No. CA-297, 22.
[17] "Morrow Cove Playground," *Oakland Tribune,* August 13, 1933, 10.; "New Bathing Beach Open on Carquinez Straits Today," *The San Francisco Examiner,* May 7, 1933.; "Morrow Cove Beach Opens Next Sunday," *Oakland Tribune,* April 30, 1933.
[18] Doug Peterson, unpublished manuscript on file at the Campus History Center.
[19] "State Acts to Ban Residents In Morrow Cove," *The Sacramento Bee,* December 9, 1941.
[20] *Hawsepipe,* 1979, 6-12.

> California Maritime Academy was established [in 1929] by an Act signed into law by California Governor Young. This legislation was called the California Nautical School Act of 1929 and made possible the formation of a state owned school to train Engineering and Deck officers of the U.S. Merchant Marine. In 1931, after two years of preparations, the first group of midshipmen were enrolled at the California Nautical School's temporary campus at the U.S. Navy Coaling Station near Tiburon [in Marin County]. [….]
>
> But the fledgling California Nautical School soon faced serious financial and political problems and was in danger of being shut down. This period of uncertainty and hardship for the school started in 1933 and lasted for about six years. There were several attempts to close the California Nautical School due to an ailing national economy and an apparent drain on desperately needed government resources. Only through the efforts of many dedicated supporters were these attempts successfully circumvented and minimal funding was continued by the state.
>
> When news came in 1939 of a possible war with Germany, the Navy needed the Tiburon coaling station and the California Nautical School had to look for another location. After more than a year of searching and after the consideration of many sites for a campus, the Board of Governors of the school decided on Morrow Cove in Vallejo. The people of Vallejo were very much in favor of the proposition and gave the school some greatly needed support. During the interim, however, the school was first moved to Pier 54 in San Francisco, and then to the Ferry Building on Pier 2 a year later.
>
> The future of the California Nautical School began to look much better with the growing demand for Merchant seamen in the early 1940's. It was during this period, […] that the California Nautical School was renamed the California Maritime Academy.[21] However, there were many delays and problems in trying to secure the expected $2.5 million estimated to develop the Morrow Cove site. In fact, after Pearl Harbor was attacked, the plans for construction of the new campus were almost completely dropped. In 1942, the Wartime Shipping Administration took over the Academy and through this agency, the original construction plans for Morrow Cove were revived.

Although the school was displaced from its Tiburon campus due to World War II, the California Maritime Academy continued to serve a critical role in the training and supplying of officers during the war. The educational program, which had introduced a three-year program for students to qualify for a merchant marine officer's license, was shortened to 18 months to supply trained officers more quickly.[22] Eleven graduates lost their lives in the line of duty during the war and were remembered at a dedication ceremony for Mayo Hall in 1946.[23] Immediately after World War II, the three-year program was restored, and the traditional training cruises were resumed. The school's annual training cruises, which provide students with hands-on experience navigating, piloting, maintaining, and running a ship, are held on the Cal Maritime Training Ship (T.S.), currently the T.S. Golden Bear III, which is on long-term loan from the United States Maritime Administration. The Academy has had four training ships: T.S. Golden State (1931–1946), T.S. Golden Bear I (1946–1971), T.S. Golden Bear II (1971–1995), and T.S. Golden Bear III (1996–present).[24] When not involved in the various cruises, the training ship is docked at the wharf adjacent to the Boathouse and provides additional educational facilities.

Despite the Academy's role in helping supply a trained Merchant Marine both during and outside of the war effort, the California Maritime Academy and the other state-run maritime academies were under threat of budget cuts and closures in the 1950s and in the 1970s. This was partially due to their complicated financial position where funding was supplied both from the federal government and each respective state legislature. In 1954, discussions on the need to crew the United States' vastly enlarged naval fleet strongly supported the ongoing funding of these institutions by the federal and state legislatures. In both instances, the value of these maritime academies was seen as essential to meeting the personnel needs of the merchant marine, the Coast Guard, and the Naval Reserve, in addition to staffing allied shipping industries – all industries that support the long-term maritime defense capabilities of the nation.[25]

Other notable milestones in Cal Maritime's history include the acceptance of women to the school in 1973, the establishment of a four-year college degree in the mid-1970s, and the full academic accreditation of the school in 1977.[26] In 1995, the California Maritime Academy became the 22nd campus of The California State University (CSU) system, officially becoming California State University Maritime Academy.[27]

[21] The adoption of the name California Maritime Academy occurred in 1939. This excerpt from *Hawsepipe* mistakenly lists the date as 1940, which appears to be incorrect based on other sources. It has therefore been omitted in this instance.
[22] "State Maritime Academy Marks 25th Anniversary," *Sacramento Bee,* September 9, 1954, F1.
[23] Peterson, *A Brief History: The California Maritime Academy Historical Archives,* 8.
[24] Cal Maritime, "History of the Training Ship Golden Bear," *Cal Maritime* (website), Accessed November 30, 2021, https://www.csum.edu/about/tsgb/history.html
[25] "California's Academy," *Maritime Reporter,* October 1, 1952, 16.
[26] *Hawsepipe*, 1979, 19.
[27] Peterson, *A Brief History: The California Maritime Academy Historical Archives,* 13.

Brief Biography of Edwin C. Miller

The Boathouse was renamed and dedicated in 1989 in honor of Edwin C. Miller, a 1934 graduate of the California Nautical School (prior to the time it became known as Cal Maritime).

Miller enrolled at the California Nautical School in 1931 and graduated in 1934.[28] He briefly returned to the school to teach in 1935, after working as a Third Mate for the Grace Lines fleet. He appears to have remained actively involved with Cal Maritime into the early 1940s, despite a career with the U.S. Navy, and he was one of the members of the survey party that visited Morrow Cove in 1940 while looking for a new campus location.

During World War II, as part of his position in the Navy, Miller was assigned to teach seamanship and navigation to cadets at Cal Maritime. In 1945, Miller left his teaching post at the school to return to a full-time position with the Navy and did not retire until 1960. At that time, Miller returned to Cal Maritime to teach for the next nine years, retiring in 1969. In 1971, Miller briefly returned to Cal Maritime to serve as Interim President and was notably the first graduate of the school to then serve as its President.

Miller was well-regarded by the staff and students of Cal Maritime. He continued to be involved in the school through its Alumni Association (of which he was a charter member). In 1989, his many contributions to the school were recognized with the dedication and renaming of the Boathouse in his honor. Edwin C. Miller passed away in 1993.

Statement of Significance:

In order for a property to be considered eligible for the National Register of Historic Places (National Register) and/or the California Register of Historical Resources (California Register), the property must possess significance and retain integrity to convey that significance. The criteria for significance are:

Criterion A/1 (Events): Associated with events that have made a significant contribution to the broad patterns of local or regional history or the cultural heritage of California or the United States.

The Boathouse at Cal Maritime was constructed from 1945-1946 and was one of the earliest permanent structures to be completed at Cal Maritime's new campus at Morrow Cove. Other structures that had already been completed by this time include the original wharf (since replaced) and Mayo Hall (completed 1945). The Boathouse, in its use and its location along the waterfront, is closely associated with the establishment of the new campus. The creation of a purpose-built campus in the 1940s was a significant investment in the establishment of the California Maritime Academy that illustrated the important role that the school had played during World War II and recognized the importance of retaining and supporting the only degree-granting maritime academy on the West Coast. The Boathouse was an important investment in the teaching facilities of the campus and, like Mayo Hall, was critical to the development of the permanent campus.[29] Additionally, the Boathouse is a unique element of the campus that is closely associated with the maritime nature of the Academy itself, and unlike the other buildings of the campus, provides a close connection to the water through its placement and its use. The Boathouse serves a key function as the location where small watercraft are stored, maintained, and repaired. It stores the necessary equipment to support the maritime activities of the students, including life jackets, oars, and sails, and supports the outfitting and running of the Training Ship. Therefore, the Boathouse appears to be eligible for the National Register and the California Register under Criterion A/1, with a period of significance that dates to 1946 and corresponds to the completion of the building.

Criterion B/2 (Persons): Associated with the lives of persons important to local, California or national history.

The Cal Maritime Boathouse is not particularly associated with any individual person such that it would be individually eligible for the National Register or the California Register under Criterion B/2. The building has been owned and operated by the Cal Maritime since its construction and has been associated with many teachers and students since the 1940s. The building was dedicated to Edwin C. Miller in 1989 to recognize his many contributions to the school, which included his many years of teaching and a period as the Interim President of Cal Maritime. While the Boathouse was dedicated in his honor, the available material on Miller's career is not clearly associated with the Boathouse and it is not known whether he was particularly involved with the use of the Boathouse during his time as a teacher at Cal Maritime. As such, the Boathouse does not appear to be eligible for the National Register nor the California Register under Criterion B/2 for its association with any individuals.

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[28] This brief biography of Edwin C. Miller is largely based on the material included in "Did You Know…?" *Pacific Northwest News*, November 2009. A copy of this publication was provided to the author by the staff of the CSU Maritime Campus History Collection.

[29] In 2018, Mayo Hall was found significant under Criteria 1 and 3. This preliminary finding was then confirmed with the preparation of DPR forms in 2020, when a rehabilitation project for Mayo Hall was undertaken that included California Public Resources Code (PRC) Section 5024 and 5024.5 consultation with the California Office of Historic Preservation (OHP). The significance evaluation of Mayo Hall under Criterion 1 stated that "the building remains a visible and prominent remnant of the early formation of the California Maritime Academy and was crucial to the school's early development." The finding of the Boathouse as significant under Criterion 1 is consistent with the previous finding for Mayo Hall.

Criterion C/3 (Architecture): Embodies the distinctive characteristics of a type, period, region or method of construction or represents the work of a master or possesses high artistic values.

The Boathouse was designed in 1945 by the California Department of Public Works, Division of Architecture, and was completed in 1946. The building is relatively simple in its design as a utilitarian Boathouse that serves the Cal Maritime waterfront. The building has undergone some alterations to its exterior and interior, but remains largely intact in regard to its materials, form, and massing. Along the exterior, alterations include the replacement of the roof, the replacement of all original double-hung wood windows with double-hung vinyl sash, the alteration to openings along the east façade where three windows were replaced with two doors and two windows, the installation of small aluminum slider windows along the east façade of the transverse wing, and the removal of an original window opening at the south façade to install a new entrance door. In areas where windows were replaced, the original openings have been retained and the replacement windows have matched the original design of a one-over-one double-hung window. At the interior, the sail loft portion of the Boathouse has been altered from its original form as a single open space with the erection of some partitions. Drop ceilings and linoleum flooring have been installed at some locations within the sail loft. Despite the Boathouse's retention of integrity (refer to the following section for analysis), it does not appear to be individually significant for its architecture as it is not a high-style example of a boathouse, nor was it designed by a master architect. Therefore, the Boathouse does not appear eligible for the National Register nor the California Register under Criterion C/3.

Criterion D/4 (Information Potential): Has yielded, or has the potential to yield, information important to the prehistory or history of the local area, California or the nation.

The "potential to yield information important to the prehistory or history of California" typically relates to archeological resources, rather than built resources. When National Register and California Register Criterion D/4 (Information Potential) does relate to built resources, it is relevant for cases when the building itself is the principal source of important construction-related information. The analysis of the property at the Boathouse for eligibility under Criterion D/4 is beyond the scope of this report.

Integrity

In order to qualify for listing in any local, state, or national historic register, a property or landscape must possess significance under at least one evaluative criterion as described above and retain integrity. Integrity is defined by the California Office of Historic Preservation as "the authenticity of an historical resource's physical identity evidenced by the survival of characteristics that existed during the resource's period of significance," or more simply defined by the National Park Service as "the ability of a property to convey its significance."[30]

Page & Turnbull used established integrity standards outlined by the *National Register Bulletin 15: How to Apply the National Register Criteria for Evaluation,* to evaluate whether the subject property retains sufficient integrity to convey its historic significance. Seven variables, or aspects, that define integrity are used to evaluate a resource's integrity—location, setting, design, materials, workmanship, feeling, and association. A property must possess most, or all, of these aspects in order to retain overall integrity. If a property does not retain integrity, it can no longer convey its significance and is therefore not eligible for listing in local, state, or national registers.

The seven aspects that define integrity are defined as follows:

> <u>Location</u> is the place where the historic property was constructed or the place where the historic event occurred;
>
> <u>Setting</u> addresses the physical environment of the historic property inclusive of the landscape and spatial relationships of the building(s);
>
> <u>Design</u> is the combination of elements that create the form, plan, space, structure, and style of the property;
>
> <u>Materials</u> refer to the physical elements that were combined or deposited during a particular period of time and in a particular pattern or configuration to form the historic property;
>
> <u>Workmanship</u> is the physical evidence of the crafts of a particular culture or people during any given period in history or prehistory;
>
> <u>Feeling</u> is the property's expression of the aesthetic or historic sense of a particular period of time; and
>
> <u>Association</u> is the direct link between an important historic event or person and the historic property.

[30] California Office of Historic Preservation, *Technical Assistance Series No. 7: How to Nominate a Resource to the California Register of Historical Resources* (Sacramento: California Office of State Publishing, 4 September 2001) 11; U.S. Department of the Interior, National Park Service, *National Register Bulletin 15: How to Apply the National Register Criteria for Evaluation* (Washington, D.C.: National Park Service, 1995) 44.

Location
The Boathouse retains integrity of location, as it has remained situated at its location of original construction since 1946.

Setting
The Boathouse largely retains integrity of setting. The Boathouse was constructed close to the entrance to the pier at the south end of the Cal Maritime campus following the regrading of the campus in the mid-1940s. While many additional structures have been erected on the campus since the completion of the Boathouse, the Boathouse has retained its original connection to the shoreline of Morrow Cove and is closely associated with the maritime activities that take place along the wharf, including the docking of the training ship. The various additional structures that have been erected near the Boathouse are temporary and utilitarian in nature and do not overwhelm the 1946 building. These buildings and structures do not block access between the Boathouse and the historic location of the pier or its access to the water of Morrow Cove. Overall, the Boathouse retains its relationship to the shoreline and its setting within the larger Cal Maritime campus.

Design
The Boathouse was designed by the California Department of Public Works, Division of Architecture and has remained largely unaltered since its erection in 1946. The building retains its overall form, massing, and material palette, and therefore its original design as a 1946 boathouse.

Materials
The Boathouse retains integrity of materials. While the building has been reroofed with asphalt shingles, and its original double-hung wood windows have been replaced with vinyl sash, the building retains its overall materials with wood shingle and vertical wood siding, original wood doors, timber pier foundations, and internal steel framing.

Workmanship
The Boathouse was designed to serve a utilitarian function as an active boathouse for Cal Maritime and has minimal decorative features. Features providing evidence of period workmanship and construction methods include its structure, which sits over the water on timber piers, its vertical wood cladding and shingles, and its original wood doors. The Boathouse retains its original materials and design elements that demonstrate the workmanship of the period.

Feeling
The Boathouse retains integrity of feeling as a working boathouse that was constructed in 1946 to serve the students of Cal Maritime and provides an essential connection between the school and the waterfront of Morrow Cove. The building is closely identified with the maritime focus of the Academy, serves an integral function for the maintenance and storage of small watercraft, and provides a key educational space for the cadets of the Academy. The building retains its location and setting that directly relate to the feeling of the building as a boathouse, and the building continues to represent the early history of the Cal Maritime campus as it was just being established.

Association
The Boathouse retains its integrity of association with the early period of construction of the Cal Maritime campus and the maritime purpose of the Academy through the retention of the Boathouse's materials, design, setting, and feeling.

Overall, the Boathouse retains all seven aspects of integrity such that it conveys its significance under Criterion A/1, with a period of significance of 1946.

Character-Defining Features
For a property to be eligible for national or state designation under criteria related to type, period, or method of construction, the essential physical features (or character-defining features) that enable the property to convey its historic identity must be evident. These distinctive character-defining features are the physical traits that commonly recur in property types and/or architectural styles. To be eligible, a property must clearly contain enough of those characteristics to be considered a true representative of a particular type, period, or method of construction, and these features must also retain a sufficient degree of integrity. Characteristics can be expressed in terms such as form, proportion, structure, plan, style, or materials.

The character-defining features of the Boathouse include, but are not limited to:

Exterior Features
- Waterfront location with close relationship to the wharf
- Building partially extends over the water
- One-story volume with a cross-gable roof
- Dock at the west side of the sail loft portion of the building
- Wood walkway along the southwest edge of the building

- Mixture of wood shingle cladding and vertical wood cladding
- Original wood doors with an applied cross-brace pattern
- Large, gridded arrangements of fixed windows
- Evenly spaced window openings with the character of one-over-one double-hung window type along the south and west façades of the sail loft portion of the building
- Large opening for boat slips

Interior Features
- Two main volumes consisting of the sail loft and the transverse wing
- Organization of the transverse wing with its work platform, boat slips, and elevated rear storage aisle
- Original wood flooring throughout the building, including wood steps
- Original wood doors with applied cross brace pattern (including the barn door between the sail loft and the transverse wing, and the door to the kitchen, originally the canvas locker)
- Wood railing and metal ladders between the elevated rear storage aisle and the boat slips

Features that are not character-defining features of the Boathouse consist of alterations that have been made to the building since its construction in 1946. These include, but are not limited to:
- Replacement windows (vinyl replacement windows are not historic)
- Non-original doors installed at the south and east façades
- Non-original windows installed at the east façade of the sail loft
- New openings with aluminum slider windows located at the east façade of the transverse wing
- In-wall air conditioning unit at the west façade

California State Historical Landmark
California State Historical Landmarks are sites, buildings, features, or events that are of statewide significance and have anthropological, cultural, military, political, architectural, economic, scientific or technical, religious, experimental, or other value. Nominated by the State Historic Resources Commission, all properties listed as a California State Historical Landmark are automatically listed on the California Register. All landmarks must address one of the following criteria for designation.[31]

Criterion 1: The first, last, only, or most significant of its type in the state or within a large geographic region (Northern, Central, or Southern California).

Cal Maritime, originally known as the California Nautical School, was established in 1929 and accepted its first students in 1931, operating temporarily from the U.S. Navy Coaling Station near Tiburon in Marin County until 1939. With the onset of World War II, the school was temporarily relocated to several pier buildings in San Francisco before construction plans for its permanent campus on Morrow Cove in Vallejo came to fruition between 1942 and 1945. Cal Maritime was the first, and remains to be the United States' only, maritime academy located on the West Coast. The propagation of the school through the 1940s reiterates its critical role in the training and supplying of naval officers and its unique proximity to American maritime defense operations in the Pacific region during World War II.

Completed in 1946, the Boathouse was the second-constructed building at the new Vallejo campus (shortly after Mayo Hall in 1945) and was important to the school's ongoing development and success. The building is illustrative of the vital connection between the campus, its curriculum, and the waterfront. However, the Boathouse is not the first, last, only, or most significant of its type in the state or within Northern California and does not carry the necessary level of significance as an individual building to be recommended as eligible for listing as a California State Historical Landmark under Criterion 1.

Criterion 2: Associated with an individual or group having a profound influence on the history of California.

The Boathouse at Cal Maritime does not have a significant association with any individual person or group having a profound influence on the history of California. It has been associated with many teachers and students since the 1940s. It has been associated with many teachers and students since the 1940s. It was dedicated to retired U.S. Naval Commander Edwin C. Miller in 1989 in recognition of his ongoing relationship with and many contributions to the school, including his years as a student (class of 1934), teacher, and Interim President (1971 – 1972). However, Miller's career is not directly associated with the Boathouse building within the Cal Maritime campus, and this name dedication appears to simply be in his honor.

[31] California Office of Historic Preservation, "California Historical Landmarks Registration," accessed online January 4, 2024, https://ohp.parks.ca.gov/?page_id=21747#:~:text=Criteria%20for%20Designation&text=The%20first%2C%20last%2C%20only%2C,on%20the%20history%20of%20California.

Therefore, the Boathouse does not appear to be eligible for individual listing as a California State Historical Landmark under Criterion 2.

Criterion 3: A prototype of, or an outstanding example of a period, style, architectural movement, or method of construction or is one of the more notable works or the best surviving work in a region of a pioneer architect, designer, or master builder.

The Boathouse at Cal Maritime is not a prototype of nor an outstanding example of a period, style, architectural movement, or method of construction. It was designed in 1945 in a utilitarian style by the California Department of Public Works, Division of Architecture to serve as an educational building and small boat storage and maintenance facility for the campus. It is not a notable work nor a best surviving example of a pioneer architecture, designer, or master builder of the region. Completed in 1946, the building has undergone some alterations to both its exterior and interior, but remains largely intact in regard to its materials, form, massing, and relationship to the waterfront of Morrow Cove and an adjacent pier (reconstructed in 1995-1997 to replace the 1940s wood wharf) where Cal Maritime's training ship is regularly docked. While the Boathouse building was critical to the overall development and success of the relocated Cal Maritime campus (from Tiburon, Marin County to Vallejo, Solano County circa 1942), it is not a unique representative of an architectural movement. Therefore, the Boathouse does not appear eligible for listing as a California State Historical Landmark under Criterion 3.

Conclusion

Cal Maritime was originally established as the California Nautical School in 1929 and was one of four degree granting maritime academies operating in the United States. The school was renamed the California Maritime Academy in 1939, and joined The California State University system in 1995, becoming the California State University Maritime Academy. The establishment of the current campus at Morrow Cove in Vallejo was a significant investment by the state and federal government during World War II that illustrated the growing need to train maritime officers who would go on to careers in the nation's maritime industries, whether that is related to naval defense or the merchant marine. The Cal Maritime campus was established at Morrow Cove in the 1940s with a permanent building campaign started in 1943.

The Boathouse, as one of the earliest permanent structures established at the campus, appears to be significant for individual listing in the National Register and the California Register under Criterion A/1 (Events) as a building that was critical to the development and success of the new campus and demonstrates the recognition of the importance of Cal Maritime in the support of national maritime industries. The Boathouse also serves an important role in demonstrating the connection of the campus to the waterfront in a way that other early permanent buildings on the campus, like Mayo Hall, do not. Under Criterion A/1, the Boathouse has a period of significance of 1946, corresponding to the year the building was completed. The California Historical Resource Status Codes (CHRSC) of "3S" and "3CS" have been assigned to the property, meaning "Appears eligible for NR individually through survey evaluation" and "Appears eligible for CR as an individual property through survey evaluation" respectively.[32]

The Boathouse does not appear to be eligible for individual listing as a California Historical Landmark under any criteria.

The Boathouse appears to be an individual historic resource for the purposes of CEQA, California Public Resources Code (PRC) 5024 review, and Section 106 review.

[32] California Office of Historic Preservation, *California Historic Resource Status Codes*, Sacramento, Updated March 2020.

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Supplementary Materials

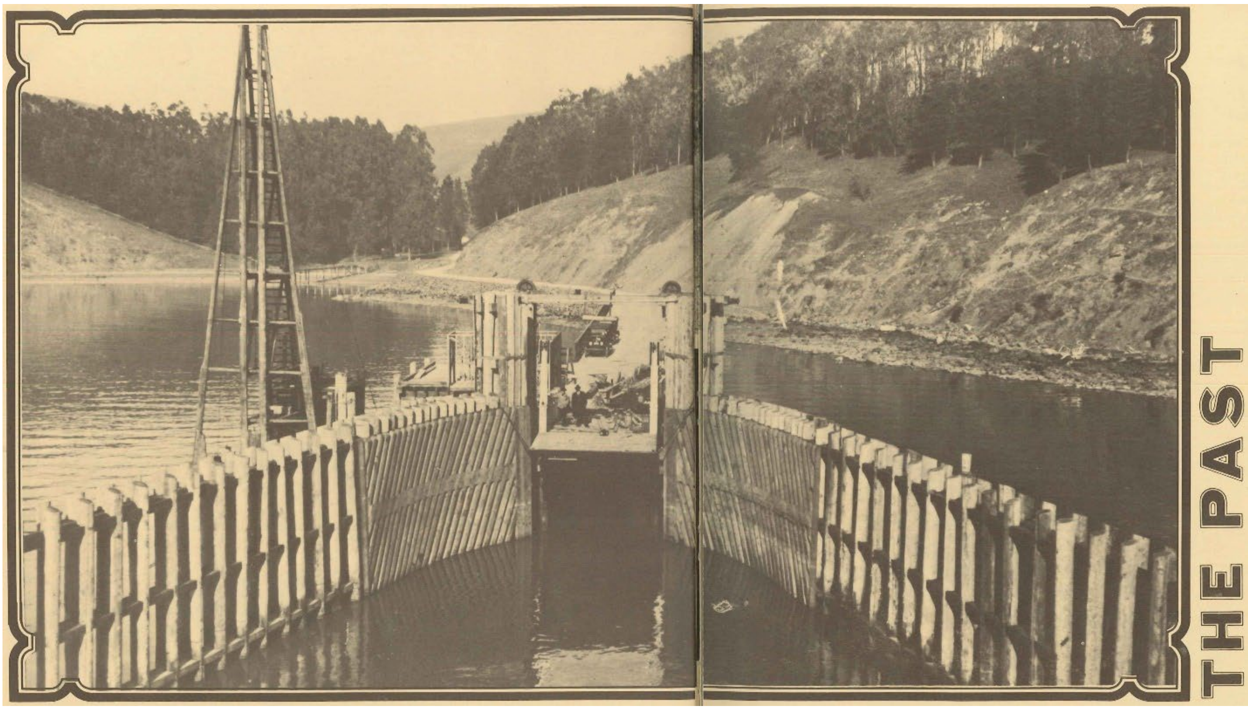


Figure 26: Undated photograph of the ferry slip at Morrow Cove where automobiles would be loaded onto the ferry to cross the Strait. Source: *Hawsepipe,* 1979.

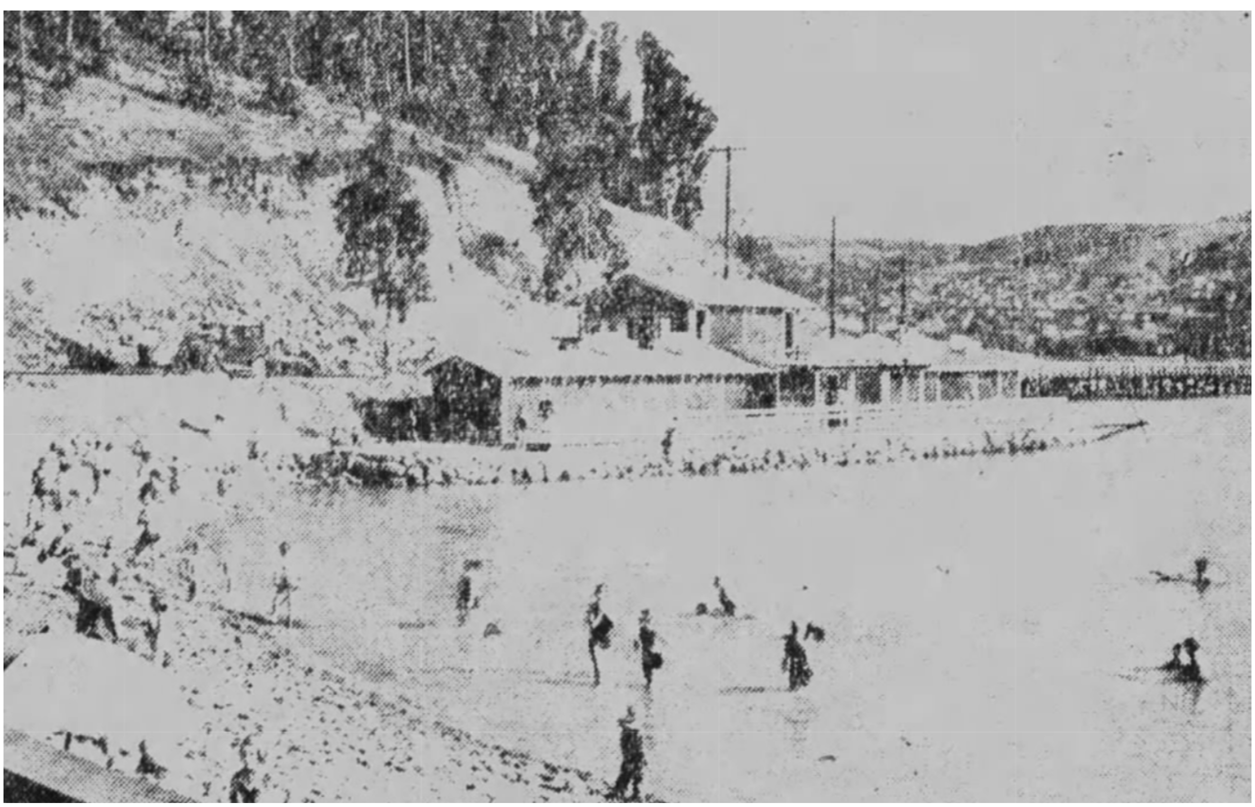


Figure 27: View of recreation area at Morrow Cove in 1933. Source: *The Oakland Tribune,* May 1933.

Figure 28: Photograph of Morrow Cove taken by Edwin C. Miller in December 1940, while at the site as part of a survey party of Maritime Academy administrators. Existing piers and structures were fully removed by 1946. At the far right is the *Contra Costa*, which served as a breakwater. Source: Cal Maritime, Campus History Collection.

Figure 29: View of the shoreline c. 1943 showing the completed wharf in the background with the T.S. Golden State. The old pier is partially extant, and the hulls of the *Contra Costa* and the *Bangor* are visible, prior to the regrading of the site. The Boathouse had not been constructed at this time. Source: *Hawsepipe*, 1979.

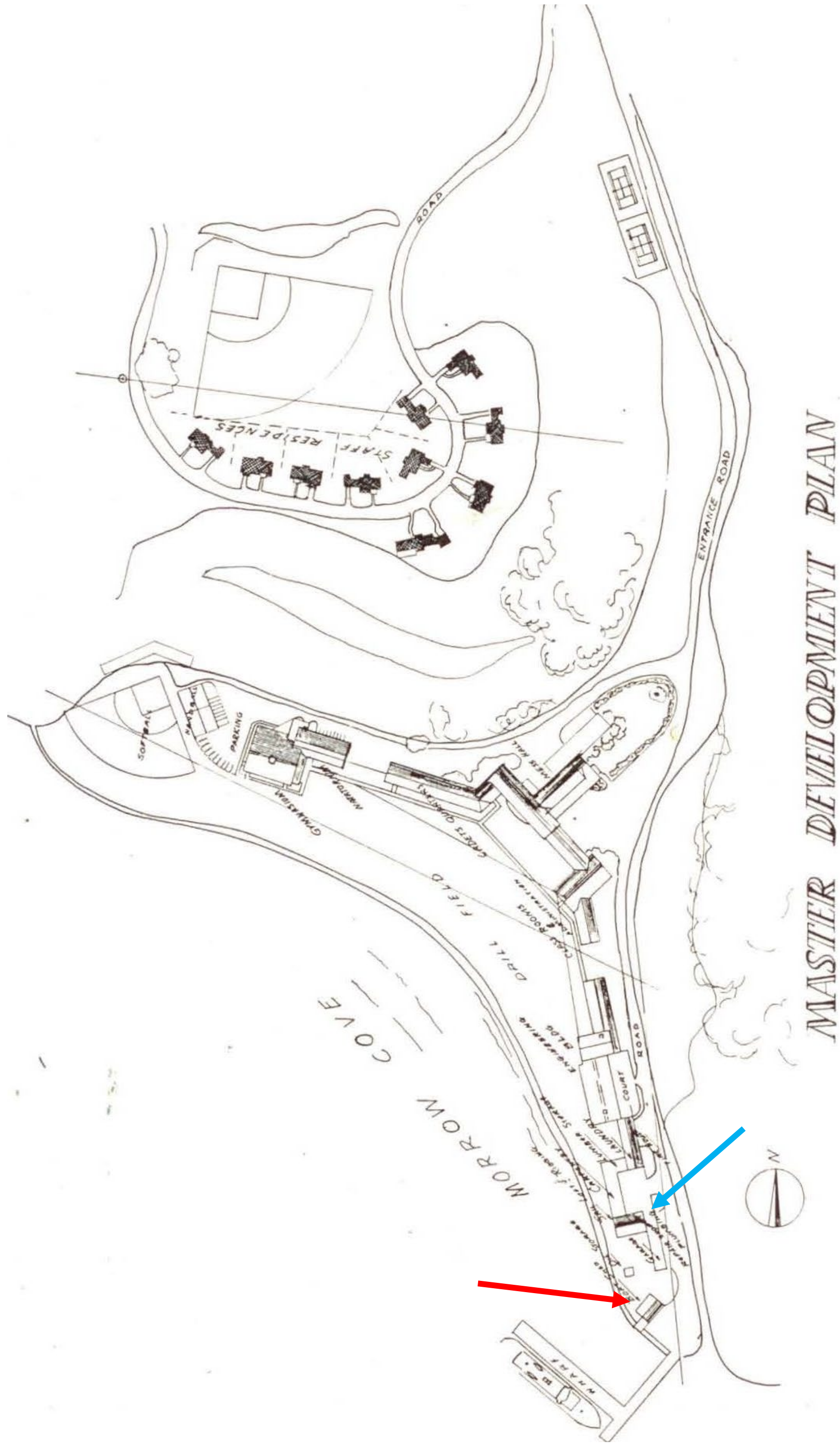


Figure 30: Master Development Plan for the Cal Maritime campus, c. 1945. Red arrow shows the location of the proposed Boat Shed; blue arrow shows the location of the proposed Sail Loft. Source: *Pacific Marine Review,* October 1945. Edited by Page & Turnbull.

Figure 31: Aerial photograph of the Cal Maritime campus with Vallejo in the background (top left of the image), c. 1961. Source: Cal Maritime Campus History Collection.

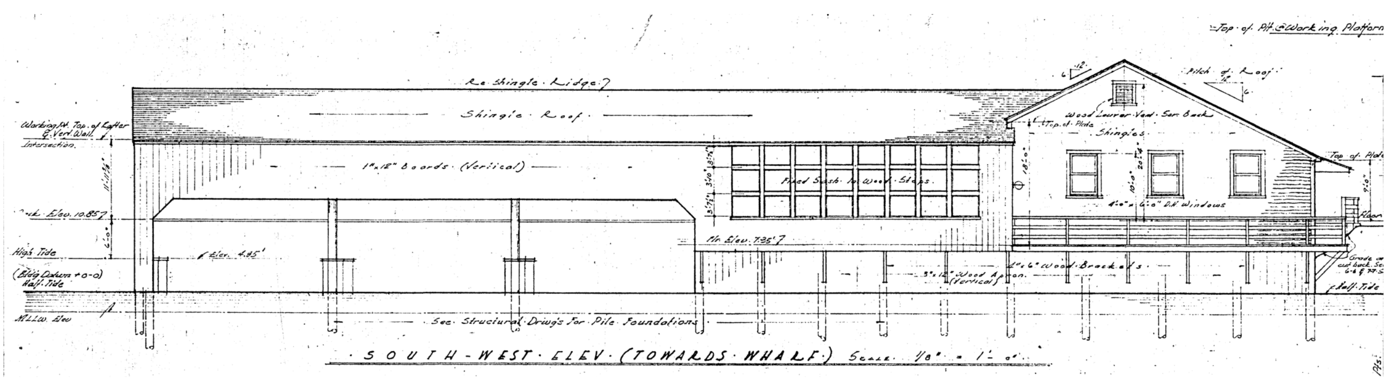


Figure 32: Detail of original drawing of Boathouse, dated December 1945. Source: Cal Maritime administration.

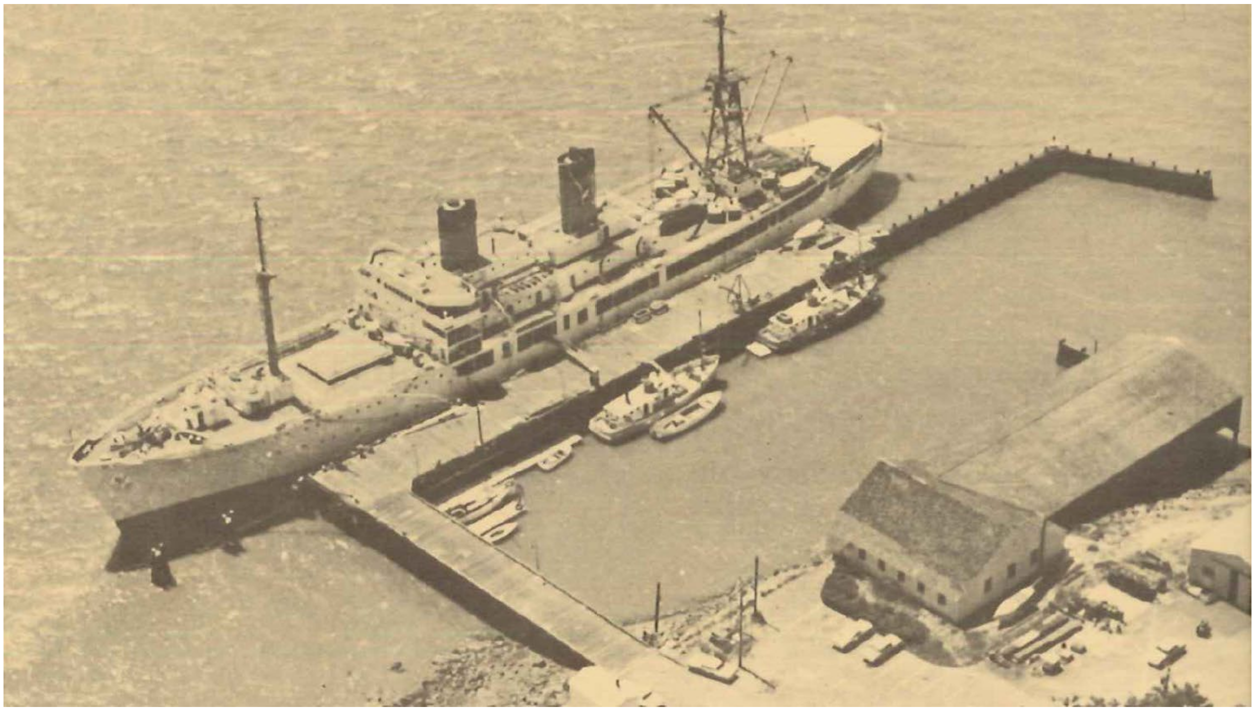


Figure 33: View of the Boathouse and docked ship, c. 1946. Source: *Hawsepipe*, 1979, Cal Maritime Campus History Collection.

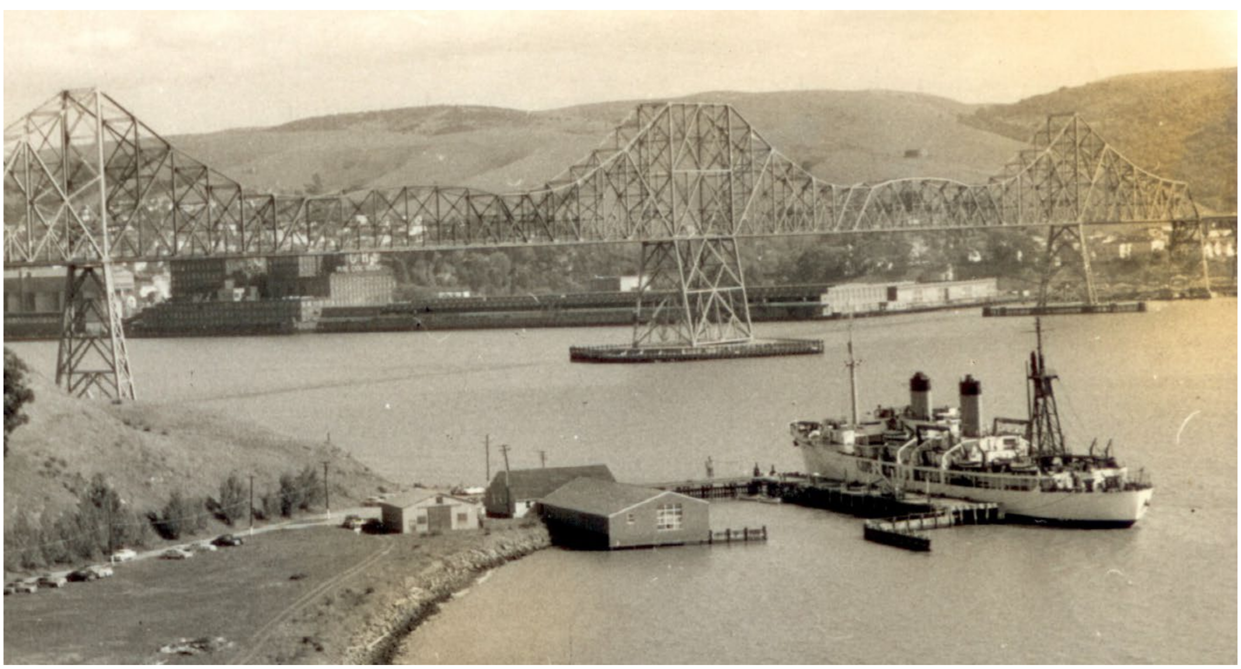


Figure 34: Looking south over the Boathouse and wharf, towards the Carquinez Bridge, c. 1948. Source: Cal Maritime, Campus History Center.

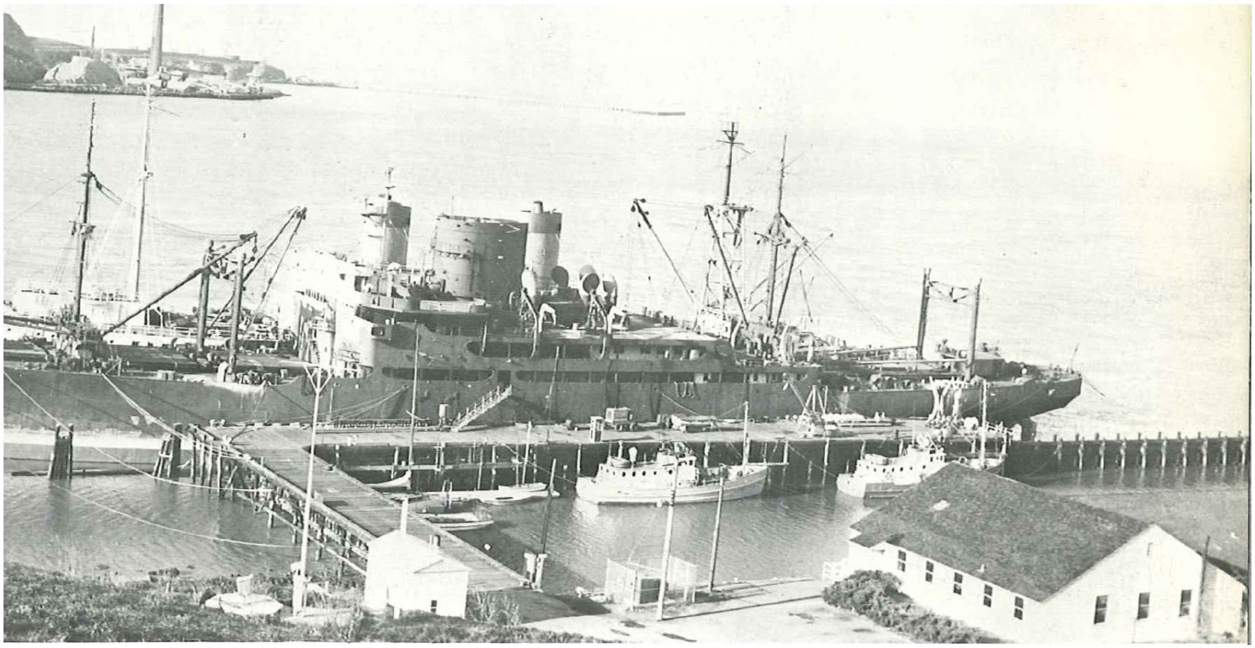


Figure 35: View of the Boathouse and wharf, c. 1971. Source: *Hawsepipe*, 1971, Cal Maritime Campus History Collection

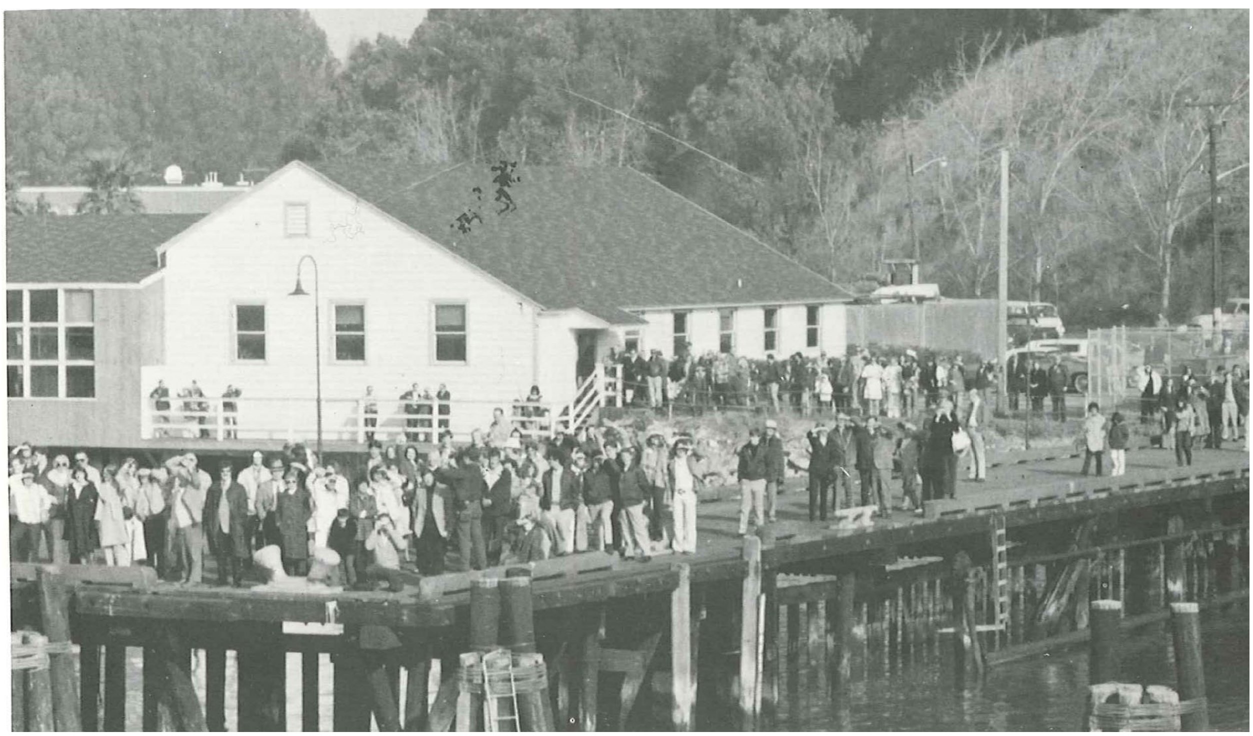


Figure 36: View of Boathouse, 1976. Source: *Hawsepipe*, 1976, Cal Maritime Campus History Collection

Figure 37: South façade of the Boathouse, door at far left of frame present by 1989. Source: *Hawsepipe*, 1990, Cal Maritime, Campus History Collection.

Figure 38: View showing the west façade of the Sail Loft portion of the Boathouse, 2008. Source: *Hawsepipe,* 2008, Cal Maritime, Campus History Collection.

Additional Historic Photographs of the Cal Maritime Boathouse

Figure 39: View of the Cal Maritime campus, 1946. Source: *Hawsepipe*, 1946, Cal Maritime Campus History Collection.

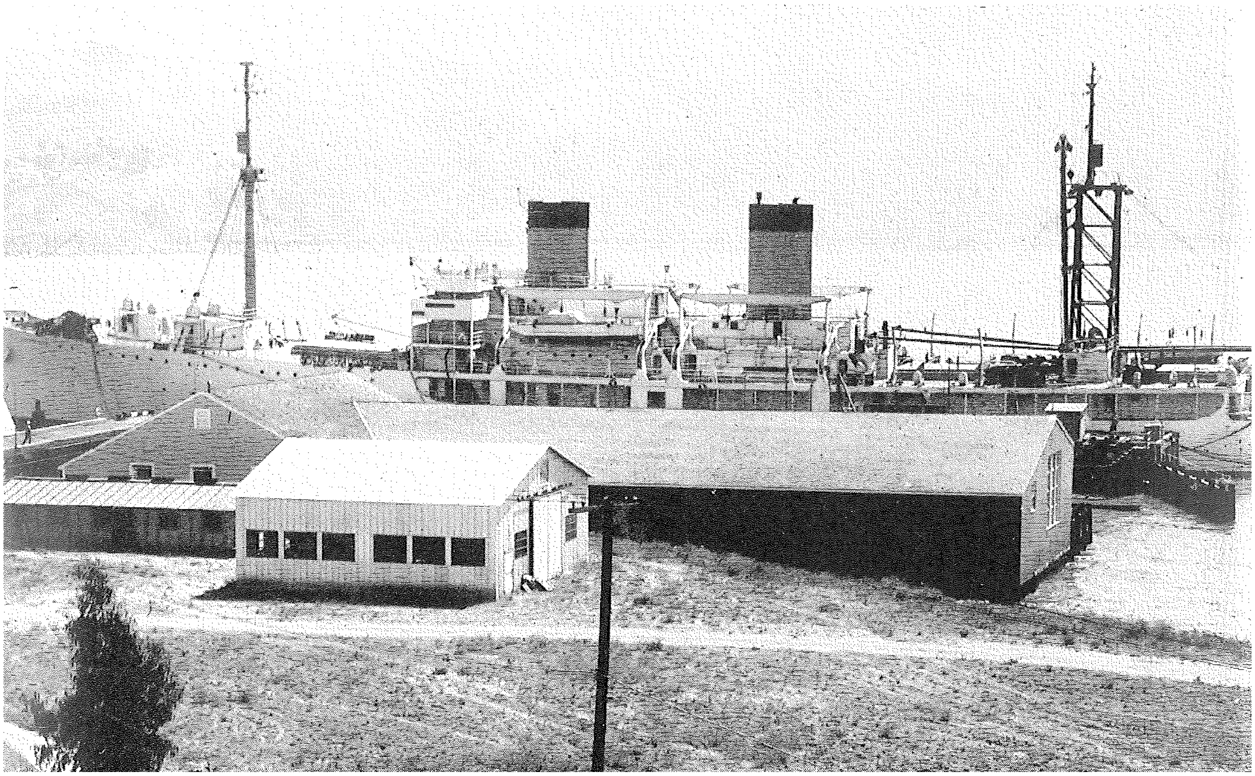


Figure 40: View of the Boathouse and wharf, 1949. Source: *Hawsepipe*, 1949, Cal Maritime Campus History Collection.

Figure 41: Aerial view of the Cal Maritime campus, 1957. Source: Cal Maritime Campus History Collection.

Figure 42: View of the Boathouse, 1958. Source: Cal Maritime, Campus History Collection.

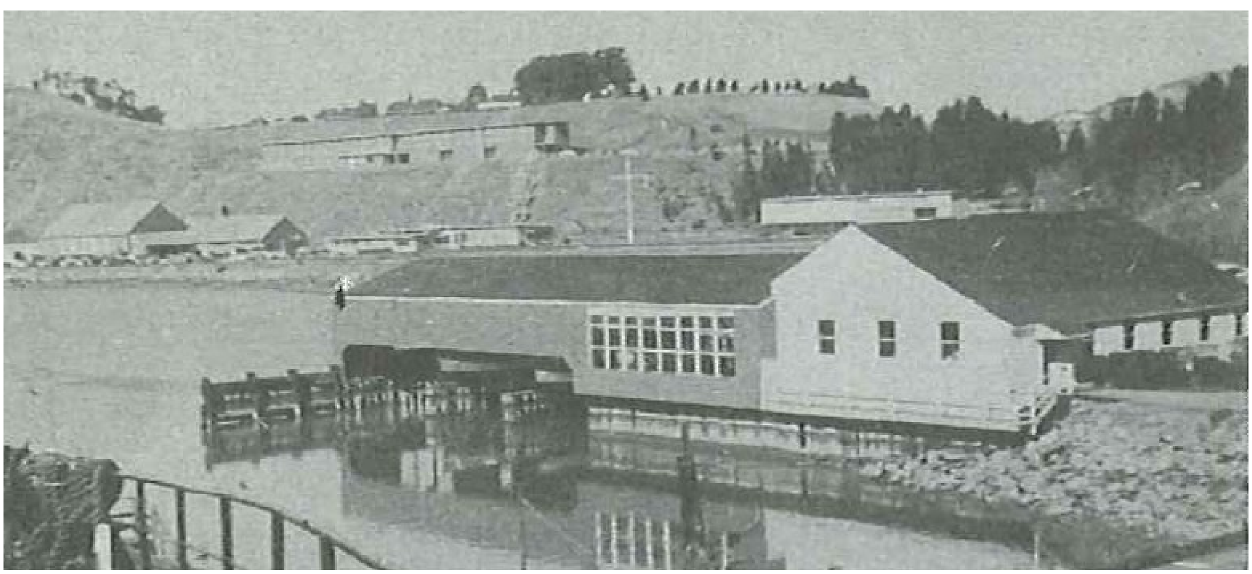


Figure 43: View of the Boathouse from the Golder Bear, 1959. Source: *Hawsepipe*, 1959, Cal Maritime Campus History Collection.

Figure 44: View of the campus looking south, c. 1959, with foundations underway for Dwyer Hall. East façade of Boathouse is visible in background. Source: Cal Maritime Campus History Collection.

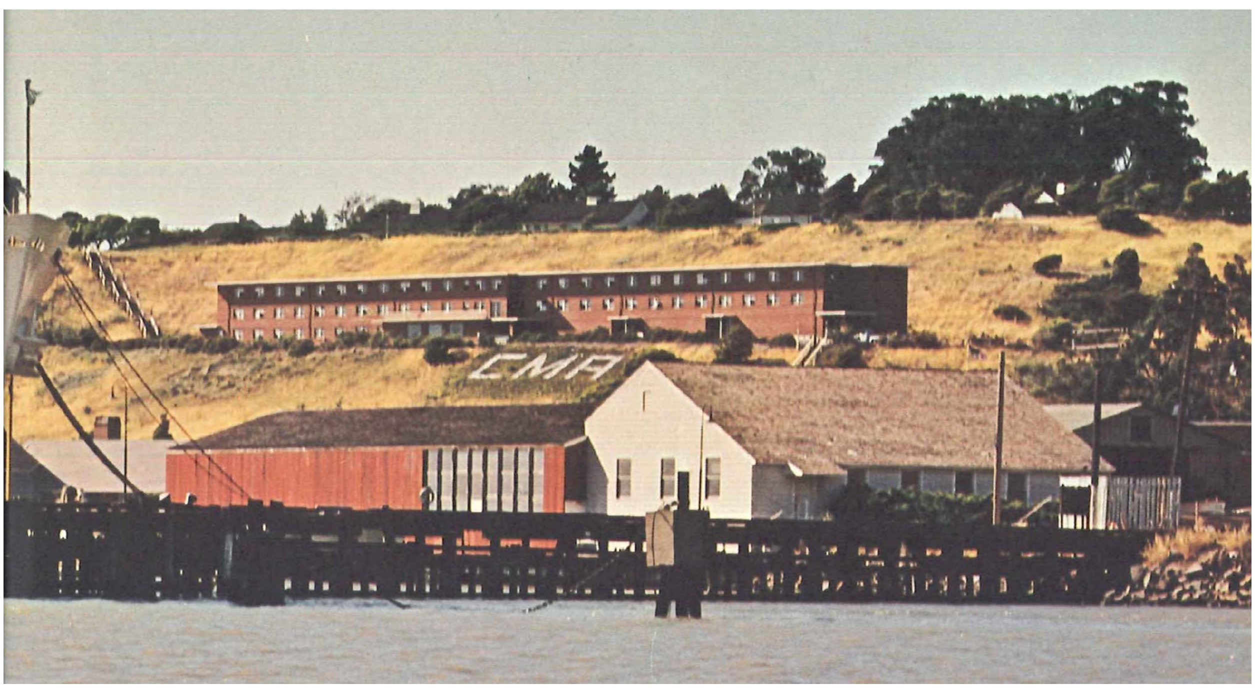


Figure 45: View of the campus with the Boathouse, c. 1968. Source: *Hawsepipe*, 1968, Cal Maritime Campus History Collection

Figure 46: West and south façades of the Boathouse,1960s. Source: Cal Maritime Campus History Collection.

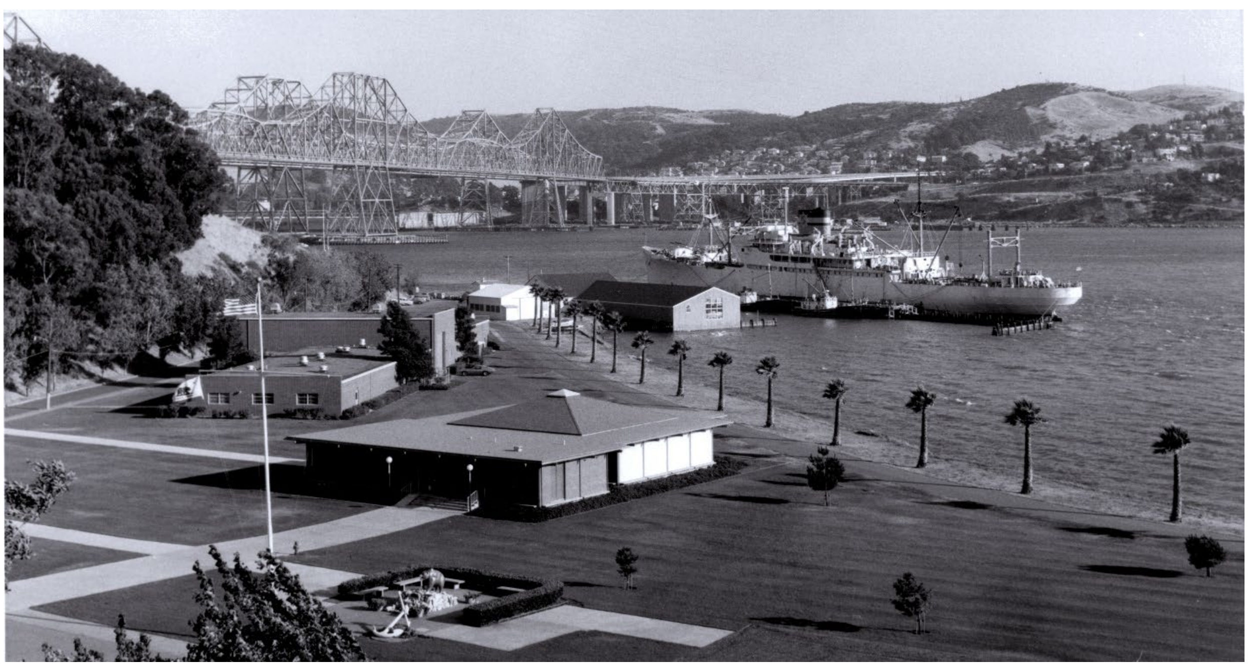


Figure 47: Boathouse in background, c. 1971. Source: Cal Maritime Campus History Collection.

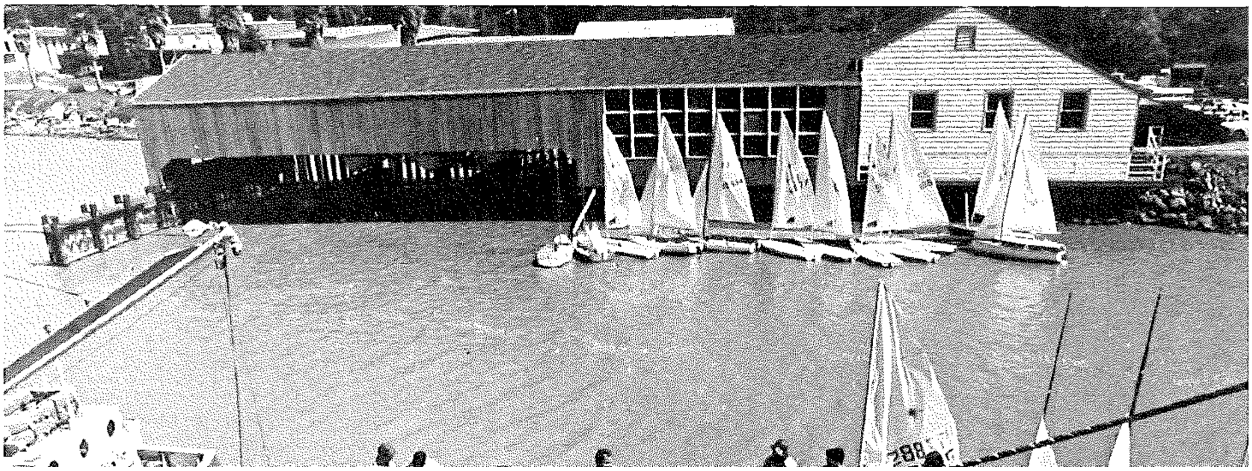


Figure 48: West façade of the Boathouse, c. 1978. Source: *Hawsepipe*, 1978, Cal Maritime Campus History Collection.

APPENDIX C

DPR 523 forms for *Cal Maritime Machine Shop* (2024).

State of California — The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
PRIMARY RECORD

Primary #
HRI #
Trinomial
NRHP Status Code

Other Listings
Review Code ______ Reviewer ______ Date ______

 Resource name(s) or number (assigned by recorder) Cal Maritime Machine Shop

P1. Other Identifier:
***P2. Location:** ☐Not for Publication ☒Unrestricted ***a. County** Solano
***b. USGS 7.5' Quad** Benicia, CA **Date** 2018
***c. Address** 200 Maritime Academy Drive **City** Vallejo **Zip** 94590
d. UTM: (Give more than one for large and/or linear resources) Zone ______ mE/ ______ mN
***e. Other Locational Data:** Solano County Assessor's Parcel Number 0062-090-030

***P3a. Description:** (Describe resource and its major elements. Include design, materials, condition, alterations, size, setting, and boundaries.)
The Cal Maritime Machine Shop is rectangular in plan and consists of two side-by-side volumes, to be referred to as the "east volume" and "west volume." The east volume was constructed in 1965, sits on a poured concrete foundation level with the ground plane, and has a low-pitch gable roof clad in standing-seam metal panels with shallow eaves. One metal exhaust pipe pierces the roof's west rake. The extant west volume, installed by 2019, appears to be a metal shipping container anchored to a raised concrete foundation. It sits under a low-slope shed-roof extension mounted to the east volume's western soffit. The overall style of the building is utilitarian.

Constructed in 1965 with an addition constructed by 2016 and expanded by 2019, the Cal Maritime Machine Shop is located on the Morrow Cove waterfront near the base of the Carquinez Bridge at the southeast end of the Cal Maritime campus (**Figure 1**). Historically, the east volume of the building (constructed circa 1965) served as a shoreside boiler facility. At present, it serves the Cal Maritime campus as a machine shop, while the west addition currently serves as a boiler room as evidenced by the multiple exhaust pipes in its roof.

The building is not aligned to the cardinal directions, but for the ease and clarity of the building description, the façade with the primary entrance overlooking the Marine Yard will be described as the north façade, the façade that faces the bay and the pier will be described as the rear/south façade, and so on. (Refer to Continuation Sheet, page 2.)

***P3b. Resource Attributes:** HP11. Engineering structure; HP39. Other
***P4. Resources Present:** ☒Building ☐Structure ☐Object ☐Site ☐District ☐Element of District ☐Other

P5a. Photo

P5b. Photo: (view and date)
Looking west, April 3, 2024.

***P6. Date Constructed/Age and Sources:** ☒Historic ☐Prehistoric ☐Both
1965, *Solano-Napa News Chronical*, "Ship Boiler Project Set," 5 November 1964.

***P7. Owner and Address:**
California State University Maritime Academy
200 Maritime Academy Drive
Vallejo, CA 94590

***P8. Recorded by:**
Maggie Nicholson, Page & Turnbull, Inc.
170 Maiden Lane, 5th Floor
San Francisco, CA 94108

***P9. Date Recorded:**
April 5, 2024

***P10. Survey Type:** Intensive

***P11. Report Citation:** None

***Attachments:** ☐None ☐Location Map ☐Sketch Map ☒Continuation Sheet ☒Building, Structure, and Object Record ☐Archaeological Record ☐District Record ☐Linear Feature Record ☐Milling Station Record ☐Rock Art Record ☐Artifact Record ☐Photograph Record ☐ Other (list)

***P3a. Description (Continued)**

Figure 1: Machine Shop at the southeast end of the Cal Maritime campus, outlined in dashed red. Source: Google Earth, 2024. Edited by Page & Turnbull.

Primary (North) Façade
The north façade of the Machine Shop contains the main entrance to the building and faces the paved parking and storage area (known as the Marine Yard) located immediately north of the pier. From this view, the differences in foundation and roof structures between the building's east (left) and west (right) volumes are most apparent. The façade is clad in several different types of corrugated metal as seen on the east volume's façade, the east volume's gable end, and the west volume's façade. The primary entrance door consists of a replacement overhead metal door centered within the east volume **(Figure 2**). Its threshold is flush with the ground. The west volume's north façade has architectural features and reads as a door assembly end of a shipping container, though it is unknown if these doors are functional (**Figure 3**). Several metal plates connect the base of the west volume to its raised concrete foundation.

Figure 2: Primary entrance on the east volume's north facade, view southwest.

Figure 3: Oblique view of the primary facade (left) and west facade (right), view southeast.

East Façade

The east façade of the Machine Shop sits under a shallow, gutter-less eave and features no openings. An in-wall air-conditioning unit is mounted near the center of the façade (**Figure 4**). The façade overlooks an adjacent metal tank, which connects to the façade via a narrow conduit. Various conduit lines also run along the base of the façade. An exterior floodlight fixture is mounted near the roofline at the center of the façade.

Figure 4: Oblique view of the Machine Shop's east facade, view north.

Rear (South) Façade

The south façade sits in close proximity to the shoreline and pier and acts as a rear entrance to the building (**Figure 5**). Like the north façade, cladding on the south façade consists of several different types of corrugated metal as seen on the east volume's façade, the east volume's gable end, and the west volume's façade. Also, like the east volume's north façade, its south façade features a prominent central door opening that is capped with a fabric awning (**Figure 6**). The doors within this opening are original partially glazed metal double doors, and the glazed portions are fixed one-over-one divided lites. The area immediately outside the door opening appears to function as an exterior workspace with a metal table.

The south façade of the west volume is slightly recessed from the east volume and several metal pipes are mounted to the facades of this corner. A metal door is located east-of-center within the west volume's south façade. Given the slight elevation change in this area of the Marine Yard, this door is accessed via stairs with metal-grate treads and landings with metal railings (**Figure 7**). To the west (left) of this door is an upright cylindrical tank labeled "condensate water" that attaches to the façade via conduit.

Resource Name or # (Assigned by recorder) Cal Maritime Machine Shop
***Recorded by** Page & Turnbull, Inc. ***Date** April 5, 2024 ☒ Continuation ☐ Update

Figure 5: South facade, view northeast from pier.

Figure 6: Awning over primary rear entrance on south façade, view east.

Figure 7: West end of the south facade, view northwest.

West Façade
The west façade of the Machine Shop is clad in corrugated metal and has relatively symmetrical openings (**Figure 8**). Vertical metal-slat vents span from the foundation to the roofline at the façade's north and south corners. Two overhead metal doors with handles at the base are near the center of the façade. A metal vent hood protrudes from the center section of façade between the doors and near the roofline. The sloping elevation of the site is evident along the foundation of the west façade, which decreases in visibility from north (left) to south (right). At the south end of the foundation, there are several shallow concrete steps, likely residual from a prior iteration of a western addition (**Figure 9**).

State of California — The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
CONTINUATION SHEET

Primary #
HRI # ______
Trinomial ______

Resource Name or # (Assigned by recorder) Cal Maritime Machine Shop
*__Recorded by__ Page & Turnbull, Inc.
***Date** April 5, 2024 ☒ Continuation ☐ Update

Figure 8: Oblique view of the primary facade (left) and west facade (right), view southeast.

Figure 9: Oblique view from the southwest corner of the building, view northeast. Arrows indicate concrete steps.

Interior of Machine Shop

The east volume interior is unfinished, so the exterior metal cladding and roofing is visible on the walls and ceiling (**Figure 10**). The ceiling is vaulted with a low slope and cross-braced with metal poles at various points along the interior ceiling line. The poured concrete foundation acts as the interior flooring. Various conduits run along the walls and ceiling, providing electrical lines for several utilitarian fluorescent-light fixtures. There is no internal circulation between the east and west volumes of the Machine Shop. The west volume interior was inaccessible during the April 3, 2024 site visit, though Cal Maritime staff confirmed that it operates as a boiler room and the volume is the housing for the associated mechanical components of that system.

Figure 10: Interior of east volume, view northeast.

BUILDING, STRUCTURE, AND OBJECT RECORD

*NRHP Status Code 6Z

*Resource Name or # Cal Maritime Machine Shop

B1. Historic name: Cal Maritime Dockside Boiler House
B2. Common name: Cal Maritime Machine Shop
B3. Original Use: Engineering/Boiler House
B4. Present use: Engineering/Machine Shop
*B5. **Architectural Style:** Utilitarian
*B6. **Construction History:** (Construction date, alterations, and date of alterations)

Due to the ownership of the campus by the California State University system, building permits are not on file with the City of Vallejo. Beyond the 1995 blueprints for an alteration of the building, staff at Cal Maritime were unable to locate permits and/or drawings in their records that depict original construction and additional alterations. An aerial photograph taken in 1965 shows the Machine Shop (**Figure 11**), and several newspaper articles from early that year confirm the date of construction to be 1965.[1]
(Continued on page 7.)

*B7. **Moved?** ☒No ☐Yes ☐Unknown **Date:** ____ **Original Location:** ____
*B8. **Related Features:** None
B9a. Architect: State Office of Architecture & Construction[2] b. Builder: Reliance Enterprises[3]
*B10. **Significance: Theme** ____ **Area** ____
Period of Significance ____ **Property Type** ____ **Applicable** ____

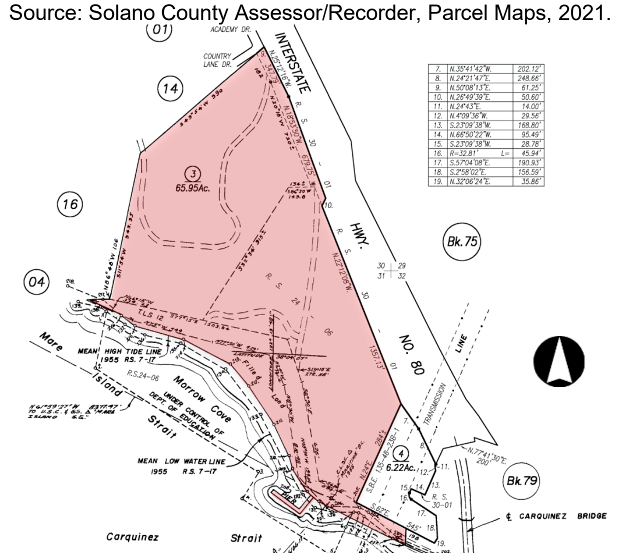
Historic Context:

History of Cal Maritime

The following brief history of the early establishment of Cal Maritime, originally called the California Nautical School, has been excerpted from the 1979 volume of *Hawsepipe,* on the 50th Anniversary of the school.[4]

> California Maritime Academy was established [in 1929] by an Act signed into law by California Governor Young. This legislation was called the California Nautical School Act of 1929 and made possible the formation of a state owned school to train Engineering and Deck officers of the U.S. Merchant Marine. In 1931, after two years of preparations, the first group of midshipmen were enrolled at the California Nautical School's temporary campus at the U.S. Navy Coaling Station near Tiburon [in Marin County]. [….]
>
> But the fledgling California Nautical School soon faced serious financial and political problems and was in danger of being shut down. This period of uncertainty and hardship for the school started in 1933 and lasted for about six years. There were several attempts to close the California Nautical School due to an ailing national economy and an apparent drain on desperately needed government resources. Only through the efforts of many dedicated supporters were these attempts successfully circumvented and minimal funding was continued by the state.
>
> When news came in 1939 of a possible war with Germany, the Navy needed the Tiburon coaling station and the California Nautical School had to look for another location. (Continued on page 9.)

Source: Solano County Assessor/Recorder, Parcel Maps, 2021.



B11. Additional Resource Attributes: N/A
*B12. **References:** See footnotes and bibliography, page 14.
B13. Remarks: N/A
*B14. **Evaluator:** Maggie Nicholson, Page & Turnbull, Inc.

***Date of Evaluation:** April 5, 2024

(This space reserved for official comments.)

[1] *Solano-Napa News Chronicle*, "Ship Boiler Project Set," 5 November 1964.
[2] *Solano-Napa News Chronicle*, "Ship Boiler Contract Let," 25 November 1964. *Solano-Napa News Chronicle*, "Boiler Job Bid Awarded," 6 January 1965.
[3] *Solano-Napa News Chronicle*, "Boiler Job Bid Awarded," 6 January 1965.
[4] *Hawsepipe,* 1979, 6-12.

***B6. Construction History (continued):**

Construction of Machine Shop (Continued)

The following list of exterior alterations have occurred since the Machine Shop was constructed in 1965. Alterations have been established through visual comparison of available historic and contemporary photographs, as well as a site inspection performed on April 3, 2024. These alterations include, but are not limited to:

- One-over-one window on the north façade replaced with partially glazed double doors at an unknown date prior to 2016 (**Figure 14**)
- Single door opening on the east façade enclosed sometime after 1971 (**Figure 15**)
- Awning installed over south façade double doors sometime after 1978 (**Figure 16**)
- Metal-clad addition with shed roof constructed at south end of west façade sometime between 2008 and December 2016 (**Figure 17** and **Figure 18**)
- Small west addition replaced by extant shipping container structure sometime between December 2016 and March 2019 (**Figure 19**)
- Partially glazed double doors on north façade of east volume replaced with overhead metal door sometime between March 2019 and present
- East volume reclad and reroofed at unknown dates, given the alterations to and enclosure of various openings.

Figure 11: Aerial view of the southeast end of the Cal Maritime campus, 1965. Subject building indicated with red outline. Source: Cartwright Aerial Surveys, Flight 65-130, Frame 50-148, 1965. Courtesy of UCSB Library Geospatial Collection. Edited by Page & Turnbull.

Figure 12: Looking east from Morrow Cove, circa 1965. Subject building indicated with dashed red outline. Source: Cal Maritime Campus History Collection.

Figure 13: View north from Morrow Cove with subject building's south façade partially shown at far right. Source: *Hawsepipe*, 1968, Cal Maritime Campus History Collection.

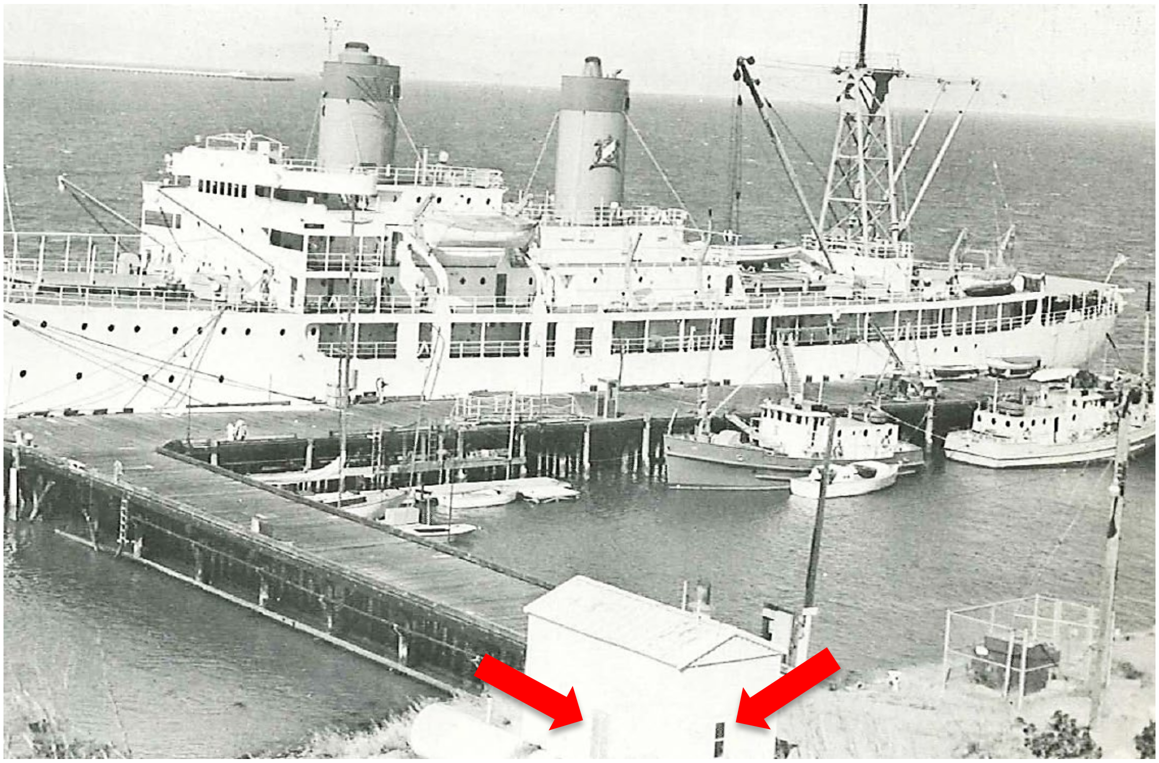


Figure 14: Looking southwest with subject building in foreground with arrows to openings that have been altered at later dates, circa 1971. Source: *Hawsepipe*, 1971, Cal Maritime Campus History Collection.

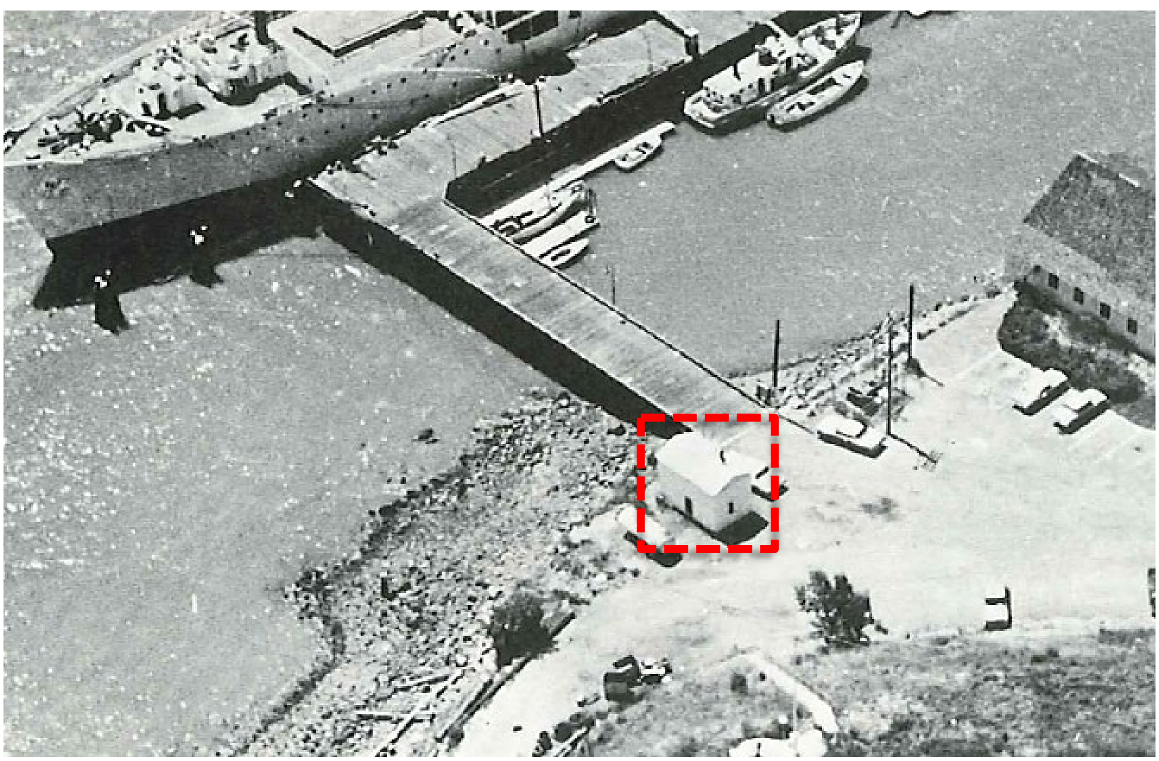


Figure 15: View of the subject building (indicated with dashed red box) and original wood wharf, 1971. Source: *Hawsepipe*, 1971, Cal Maritime Campus History Collection.

Figure 16: View east from the training ship to shore, showing south and west facades of subject building, 1978. Source: *Hawsepipe*, 1978, Cal Maritime Campus History Collection.

Figure 17: View showing a portion of the Boathouse's south façade (foreground) and the Machine Shop's west façade (background), 2008. Source: *Hawsepipe,* 2008, Cal Maritime Campus History Collection.

Figure 18: Oblique view of the Machine Shop's primary and west facades, view southeast, December 2016. Source: Google Street View.

Figure 19: Oblique view of the Machine Shop's primary and west facades, view southeast, March 2019. Source: Google Street View.

***B10. Significance (Continued):**

History of Cal Maritime (Continued)

After more than a year of searching and after the consideration of many sites for a campus, the Board of Governors of the school decided on Morrow Cove in Vallejo. The people of Vallejo were very much in favor of the proposition and gave the school some greatly needed support. During the interim, however, the school was first moved to Pier 54 in San Francisco, and then to the Ferry Building on Pier 2 a year later.

The future of the California Nautical School began to look much better with the growing demand for Merchant seamen in the early 1940's. It was during this period, […] that the California Nautical School was renamed the California Maritime Academy.[5] However, there were many delays and problems in trying to secure the expected $2.5 million estimated to develop the Morrow Cove site. In fact, after Pearl Harbor was attacked, the plans for construction of the new campus were almost completely dropped. In 1942, the Wartime Shipping Administration took over the Academy and through this agency, the original construction plans for Morrow Cove were revived.

[5] The adoption of the name California Maritime Academy occurred in 1939. This excerpt from *Hawsepipe* mistakenly lists the date as 1940, which appears to be incorrect based on other sources. It has therefore been omitted in this instance.

Although the school was displaced from its Tiburon campus due to World War II, the California Maritime Academy continued to serve a critical role in the training and supplying of officers during the war. The educational program, which had introduced a three-year program for students to qualify for a merchant marine officer's license, was shortened to 18 months to supply trained officers more quickly.[6] Eleven graduates lost their lives in the line of duty during the war and were remembered at a dedication ceremony for Mayo Hall in 1946.[7] Immediately after World War II, the three-year program was restored, and the traditional training cruises were resumed. The school's annual training cruises, which provide students with hands-on experience navigating, piloting, maintaining, and running a ship, are held on the Cal Maritime Training Ship (T.S.), currently the T.S. Golden Bear III, which is on long-term loan from the United States Maritime Administration. The Academy has had four training ships: T.S. Golden State (1931–1946), T.S. Golden Bear I (1946–1971), T.S. Golden Bear II (1971–1995), and T.S. Golden Bear III (1996–present).[8] When not involved in the various cruises, the training ship is docked at the wharf adjacent to the Boathouse and provides additional educational facilities.

Despite the Academy's role in helping supply a trained Merchant Marine both during and outside of the war effort, the California Maritime Academy and the other state-run maritime academies were under threat of budget cuts and closures in the 1950s and in the 1970s. This was partially due to their complicated financial position where funding was supplied both from the federal government and each respective state legislature. In 1954, discussions on the need to crew the United States' vastly enlarged naval fleet strongly supported the ongoing funding of these institutions by the federal and state legislatures. In both instances, the value of these maritime academies was seen as essential to meeting the personnel needs of the merchant marine, the Coast Guard, and the Naval Reserve, in addition to staffing allied shipping industries – all industries that support the long-term maritime defense capabilities of the nation.[9]

Other notable milestones in Cal Maritime's history include the acceptance of women to the school in 1973, the establishment of a four-year college degree in the mid-1970s, and the full academic accreditation of the school in 1977.[10] In 1995, the California Maritime Academy became the 22nd campus of The California State University (CSU) system, officially becoming California State University Maritime Academy.[11]

Statement of Significance:

In order for a property to be considered eligible for the National Register of Historic Places (National Register) and/or the California Register of Historical Resources (California Register), the property must possess significance and retain integrity to convey that significance. The criteria for significance are:

Criterion A/1 (Events): Associated with events that have made a significant contribution to the broad patterns of local or regional history or the cultural heritage of California or the United States.

The Machine Shop at Cal Maritime was constructed in 1965 and originally served as a dockside boiler house within the Marine Yard. In its original use and its location along the waterfront, the subject building was closely associated with the maritime operations occurring within the vicinity of the Marine Yard, pier, and training ship. However, it does not appear to be eligible for listing under Criterion A/1 for its association with any events that have made a significant contribution to the broad patterns of local or regional history, or the cultural heritage of California or the United States.

Criterion B/2 (Persons): Associated with the lives of persons important to local, California or national history.

Research did not provide evidence that any historically significant persons have been associated with the Machine Shop at Cal Maritime. Therefore, the subject building does not appear to be eligible for listing under Criterion B/2 for its association with individuals who have made important contributions to local, state, or national history.

[6] "State Maritime Academy Marks 25th Anniversary," *Sacramento Bee,* September 9, 1954, F1.
[7] Peterson, *A Brief History: The California Maritime Academy Historical Archives,* 8.
[8] Cal Maritime, "History of the Training Ship Golden Bear," *Cal Maritime* (website), Accessed November 30, 2021, https://www.csum.edu/about/tsgb/history.html
[9] "California's Academy," *Maritime Reporter,* October 1, 1952, 16.
[10] *Hawsepipe*, 1979, 19.
[11] Peterson, *A Brief History: The California Maritime Academy Historical Archives,* 13.

Criterion C/3 (Architecture): Embodies the distinctive characteristics of a type, period, region or method of construction or represents the work of a master or possesses high artistic values.

The Machine Shop at Cal Maritime was built in 1965. It is utilitarian in design, incorporating common building techniques and materials, such as corrugated metal siding. No evidence was uncovered through research to suggest that the architect, the State Office of Architecture & Construction, was significant or that the builder, Reliance Enterprises, is one of merit. The subject building does not embody distinctive characteristics of a type, period, region, or method of construction nor is it a representative example of an architect or builder of merit, as required for eligibility under this criterion. Therefore, the Machine Shop does not appear eligible for the National Register or the California Register under Criterion C/3.

Criterion D/4 (Information Potential): Has yielded, or has the potential to yield, information important to the prehistory or history of the local area, California or the nation.

The "potential to yield information important to the prehistory or history of California" typically relates to archeological resources, rather than built resources. When National Register and California Register Criterion D/4 (Information Potential) does relate to built resources, it is relevant for cases when the building itself is the principal source of important construction-related information. As the building was constructed with utilitarian materials and techniques, it would be unlikely to yield information related to unique or rare construction techniques. Therefore, the Machine Shop does not appear to be eligible for individual significance under Criterion D/4.

Integrity
As the subject building was not found individually significant under any National Register or California Register criteria, an analysis of historic integrity was not conducted.

California State Historical Landmark
California State Historical Landmarks are sites, buildings, features, or events that are of statewide significance and have anthropological, cultural, military, political, architectural, economic, scientific or technical, religious, experimental, or other value. Nominated by the State Historic Resources Commission, all properties listed as a California State Historical Landmark are automatically listed on the California Register. All landmarks must address one of the following criteria for designation.[12]

Criterion 1: The first, last, only, or most significant of its type in the state or within a large geographic region (Northern, Central, or Southern California).

Constructed in 1965, the Machine Shop within the Cal Maritime campus does not appear to be the first, last, only, or most significant machine shop building type in the state, or within Northern California. The building does not carry the necessary level of significance as an individual building to be eligible for listing as a California State Historical Landmark under Criterion 1.

Criterion 2: Associated with an individual or group having a profound influence on the history of California.

The Machine Shop at Cal Maritime does not have a significant association with any individual person or group having a profound influence on the history of California. Therefore, it does not appear to be eligible for individual listing as a California State Historical Landmark under Criterion 2.

Criterion 3: A prototype of, or an outstanding example of a period, style, architectural movement, or method of construction or is one of the more notable works or the best surviving work in a region of a pioneer architect, designer, or master builder.

The Machine Shop at Cal Maritime is not a prototype of nor an outstanding example of a period, style, architectural movement, or method of construction. It was constructed in 1965 in a utilitarian style by Reliance Enterprises of Santa Rosa, California to serve as a dockside boiler house. The building was subsequently altered at both its exterior and interior to convert the east volume from a boiler house to a machine shop and to construct the new west volume of the building as a new boiler house. The building is not a notable work nor a best surviving example of a pioneer architect, designer, or master builder of the region, and it is not a unique representative of an architectural movement. Therefore, the Machine Shop does not appear eligible for listing as a California State Historical Landmark under Criterion 3.

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[12] California Office of Historic Preservation, "California Historical Landmarks Registration," accessed online January 4, 2024, https://ohp.parks.ca.gov/?page_id=21747#:~:text=Criteria%20for%20Designation&text=The%20first%2C%20last%2C%20only%2C,on%20the%20history%20of%20California.

Conclusion

The Machine Shop at Cal Maritime does not appear to be historically significant under any of the four eligibility criteria, and therefore appears to be ineligible for listing in the National Register and the California Register. The California Historical Resource Status Codes (CHRSC) of "6Z" has been assigned to the property, meaning "Found ineligible for NR, CR, or local designation through survey evaluation."[13]

The Machine Shop does not appear to be eligible for individual listing as a California Historical Landmark under any criteria.

The Machine Shop does not appear to be an individual historic resource for the purposes of CEQA, California Public Resources Code (PRC) 5024 review, and/or Section 106 review.

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PAGE & TURNBULL

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Appendix H

Preliminary Geotechnical Recommendations

DRAFT

Table X – Preliminary Soil/Bedrock Adhesion Values for Use in Evaluation of Uplift Capacity of Steel Pipe Piles

Layer		Undrained Shear Strength (psf)	Ultimate Adhesion (psf)	Notes
Bay Deposits[1]	Depth (feet)			Neglect upper 5 feet of recent sediments for uplift resistance.
	0 - 10	250	250[4]	
	10 - 30	500	500[4]	
	30+	800	700[4]	
Competent Soil[2]		3,000	1,000[4]	Competent soil generally comprised of stiff to very stiff clays and intensely weathered/decomposed bedrock.
Bedrock[3]		N/A	5,000[5]	Value for drilled/grouted rock anchor at pile tip. Reference: Table 5-3 FHWA Micropile Design and Construction Reference Manual (2005).

Subsurface conditions at the site are comprised of Bay Deposits underlain by Competent Soil and Bedrock at depth as depicted on Cross Section A (attached). Values provided are preliminary and should not be used for final design.

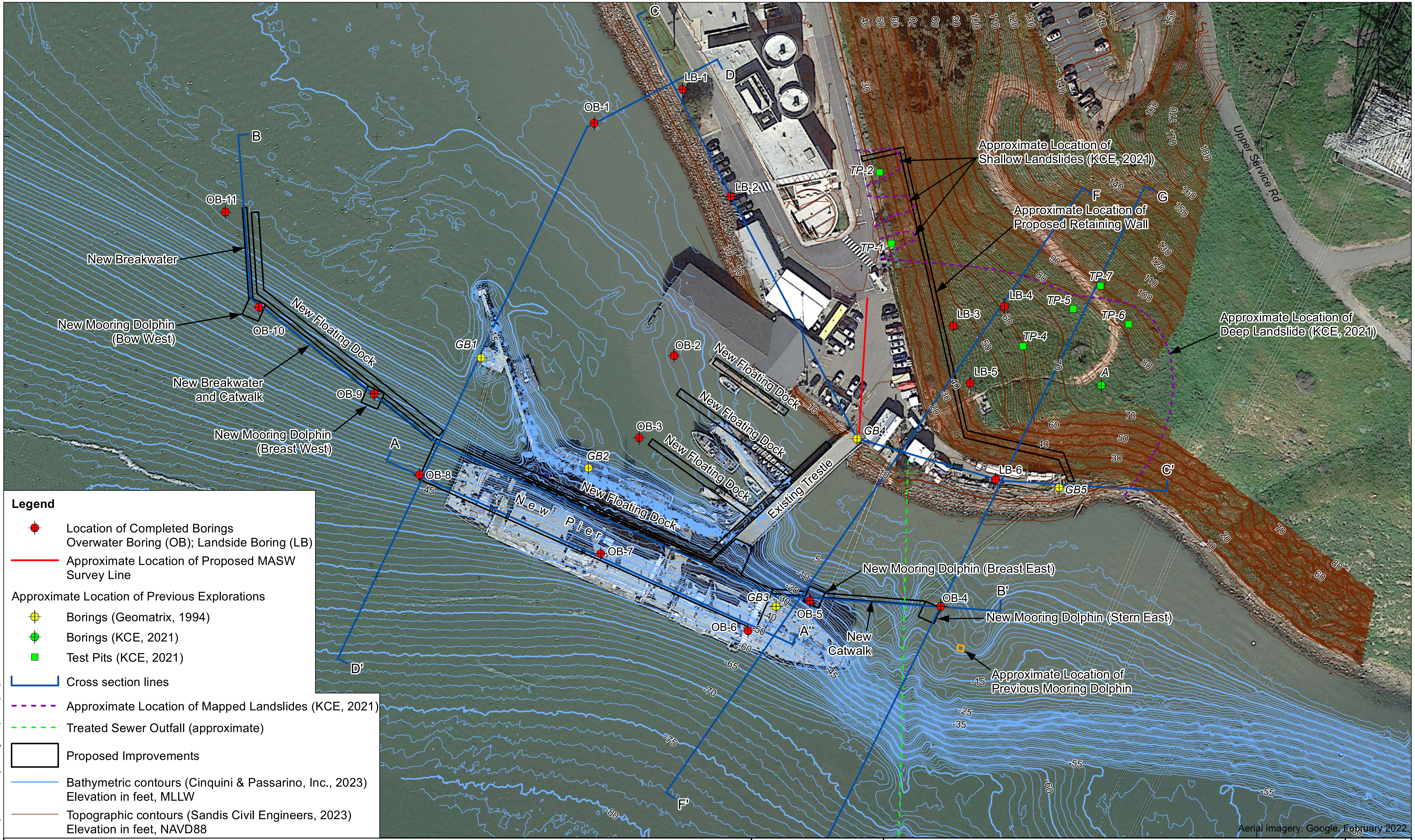
1. Refer to attached Figure X for thickness of bay deposits. The depths noted in Table X are relative to mudline (depth below mudline or top of bay deposits).
2. Refer to attached Figure Y for thickness of competent soil.
3. The approximate tip elevation of piles driven to refusal in bedrock should be estimated from Figure Z.
4. Adhesion based on α values from Tomlinson (1980). Appropriate safety factor should be applied.
5. Minimum value for "Soft Shale." Higher values may be realized in sandstone bedrock. Load tests should be conducted to validate actual values. Appropriate safety factor should be applied.

Table Y – Preliminary LPILE Soil Parameters for Lateral Pile Analysis

Layer	Depth (feet)	Effective Unit Weight (pcf)	k value (pci)	Undrained Shear Strength (psf)	Internal Friction (degrees)	Strain Factor ε_{50}	P-Y Curve Model
	0 - 10			250		0.02	
Bay Deposits[1]	10 - 30	33	NA	500	0	0.02	Soft Clay
	30+			800		0.01	
Competent Soil[2]	0 - 30	55	1,000 Static 400 Cyclic	3,000	0	0.005	Stiff Clay Without Free Water

Subsurface conditions at the site are comprised of Bay Deposits underlain by Competent Soil and Bedrock at depth as depicted on Cross Section A (attached). Values provided are preliminary and should not be used for final design.

1. Refer to attached Figure X for thickness of bay deposits. The depths noted in Table Y are relative to mudline (depth below mudline or top of bay deposits).
2. Refer to attached Figure Y for thickness of competent soil. The depths noted in Table Y are relative to the top of competent soil (depth below top of competent soil).
3. The approximate tip elevation of piles driven to refusal in bedrock should be estimated from Figure Z.
4. The lateral resistance of small diameter grouted tiedown anchors in bedrock should be neglected.



Note: MLLW = NAVD88 + 0.4' (Based on NOAA Crockett, Carquinez Strait, Station ID 9415143)

DRAFT

GANNETT FLEMING

EXPLORATION PLAN

California Maritime Academy
Vallejo, California

FIGURE 1

Date: 1/8/2024	By: M. Ticci	Scale: 1:1,200	Project No: 075807

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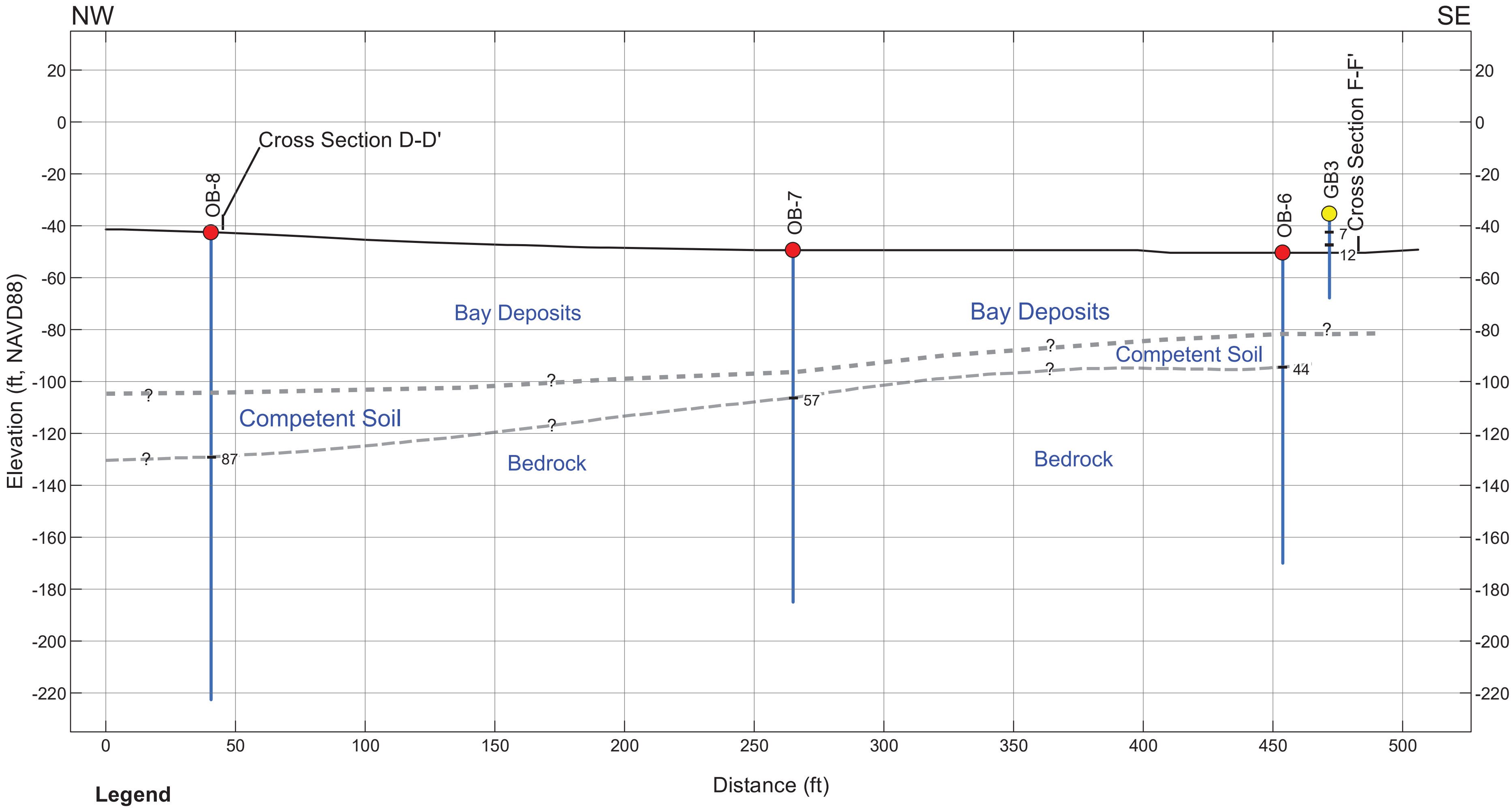


Legend

- Borings (Gannett Fleming, 2023)
- Historical Borings (Geomatrix, 1994)
- Boring depth, showing material layer contacts
- Bathymetric Surface
- Approximate Layer Contact (based on Gannett Fleming, 2023 borings)

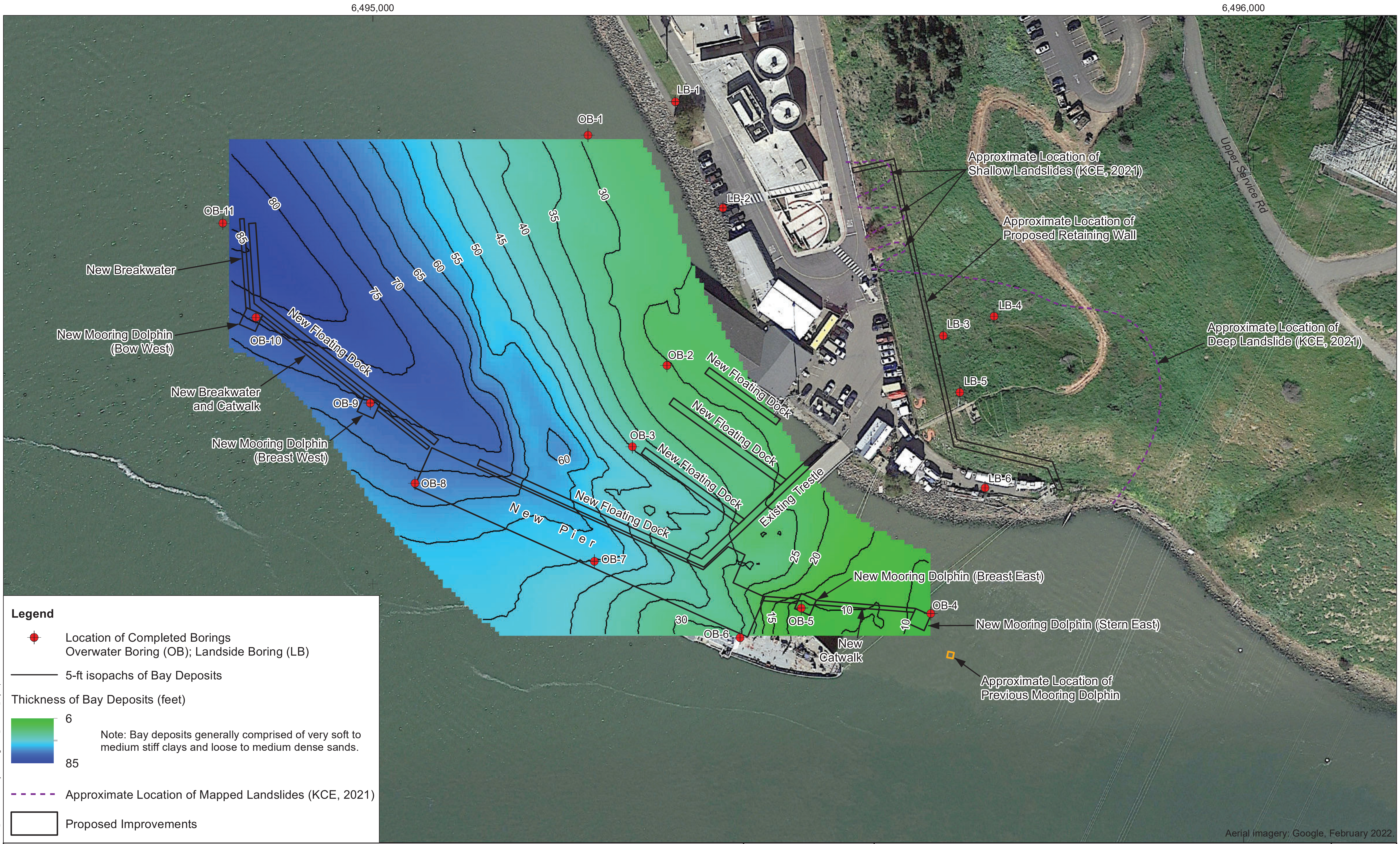
GANNETT FLEMING

DRAFT

CROSS SECTION A-A'
California Maritime Academy
Vallejo, California

FIGURE A

Date: 1/2023	By: M. Ticci	Scale: AS SHOWN	Project No: 075807



N

0 50 100 ft

0 20 40 m

Note: The thickness of bay deposits is approximate and based on conditions encountered in widely spaced borings. Actual conditions may vary. Changes can occur with the passage of time, whether due to natural processes or the works of man.

DRAFT

GANNETT FLEMING

THICKNESS OF BAY DEPOSITS

California Maritime Academy
Vallejo, California

FIGURE X

Date: 12/22/2023 | By: M. Ticci | Scale: 1:1,200 | Project No: 075807

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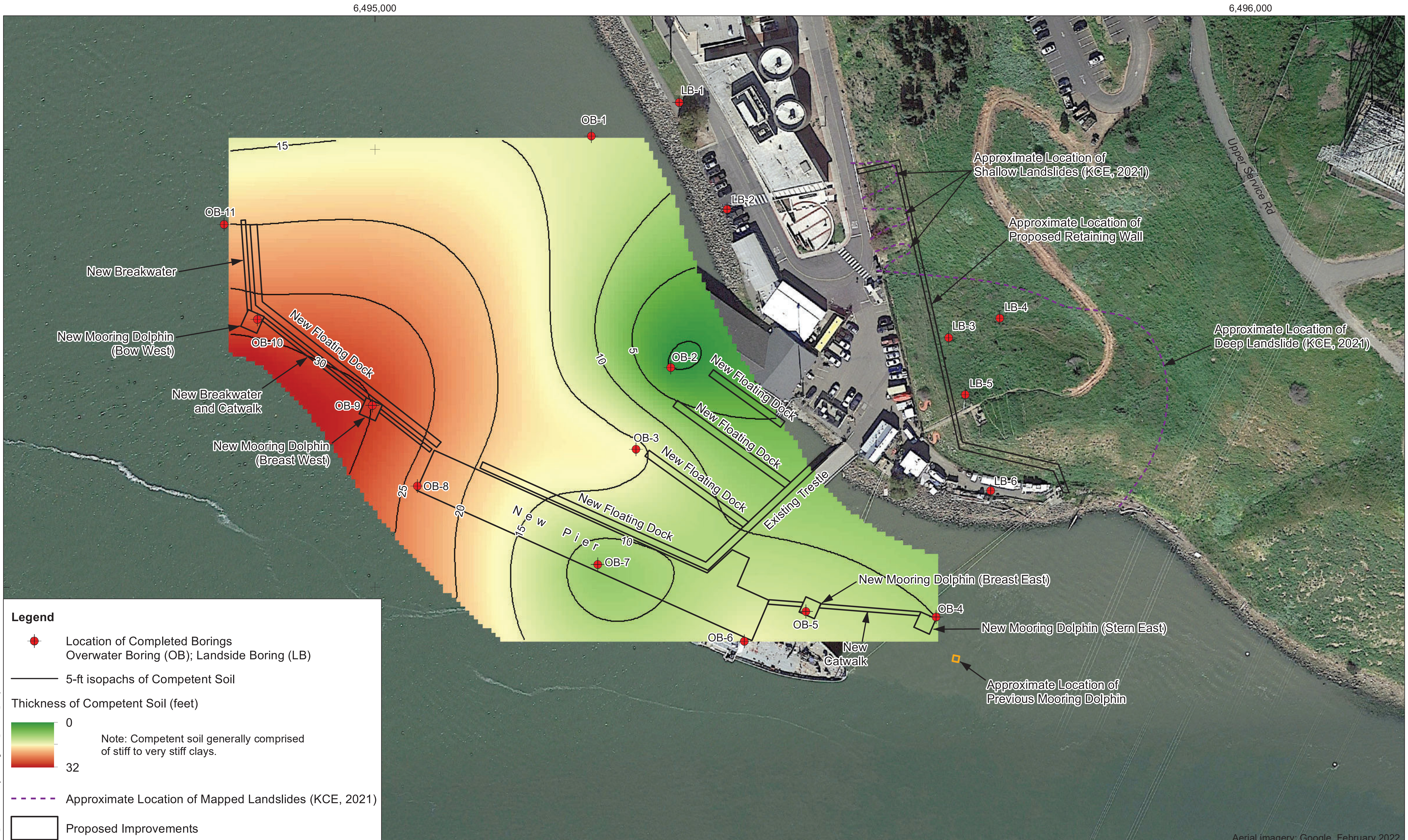

Note: The thickness of competent soil is approximate and based on conditions encountered in widely spaced borings. Actual conditions may vary. Changes can occur with the passage of time, whether due to natural processes or the works of man.

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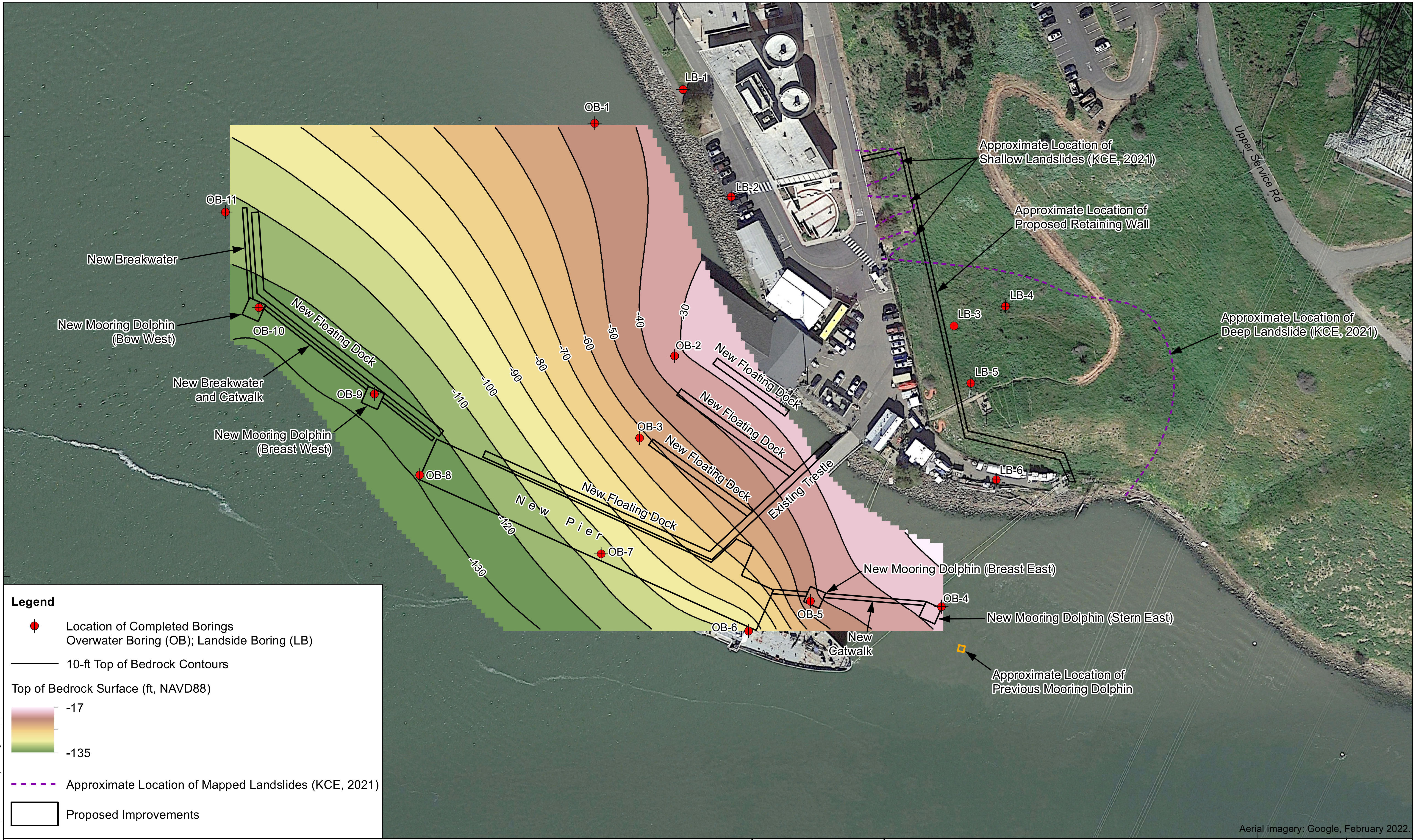
GANNETT FLEMING

THICKNESS OF COMPETENT SOIL

California Maritime Academy
Vallejo, California

FIGURE Y

Date: 12/21/2023	By: M. Ticci	Scale: 1:1,200	Project No: 075807



\\cphfs23\EnvSciLt\Projects\07\075807_MaritimeAcademy\MXD\Figures\2_TopBedrock.mxd, 12/21/2023, mticci

N

0 50 100 ft

0 20 40 m

Note: Top of bedrock elevations are approximate and based on conditions encountered in widely spaced borings. Actual conditions may vary. Changes can occur with the passage of time, whether due to natural processes or the works of man.

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GANNETT FLEMING

TOP OF BEDROCK ELEVATION

California Maritime Academy
Vallejo County, California

FIGURE Z

Date: 12/21/2023	By: M. Ticci	Scale: 1:1,200	Project No: 075807

Appendix I

Noise Measurement Data and Noise Modeling Calculations

Traffic Noise Spreadsheet Calculator

Project: **Truckee KidZone Museum**

Noise Level Descriptor: CNEL
Site Conditions: Hard
Traffic Input: ADT
Traffic K-Factor:

	Segment Description and Location			Input										Output				
						Distance to Directional Centerline, (feet)4		Traffic Distribution Characteristics						xxx ft. CNEL,	Distance to Contour, (feet)3			
Number	**Name**	**From**	**To**	**ADT**	**Speed (mph)**	**Near**	**Far**	**% Auto**	**% Medium**	**% Heavy**	**% Day**	**% Eve**	**% Night**	**(dBA)5,6,7**	**75 dBA**	**70 dBA**	**65 dBA**	**78.9 dBA**
Existing + Project Conditions																		
15	Blue Ravine Road	E. Bidwell Street	Oak Avenue Parkway	16,544	45	100	100	97.0%	2.0%	1.0%	80.0%	15.0%	5.0%	66.86	15	49	154	6
#REF!	Blue Ravine Road	Riley Street	E. Bidwell Street	20,356	45	100	100	97.0%	2.0%	1.0%	80.0%	15.0%	5.0%	67.77	19	60	189	8
*All modeling	Creekside Drive	Harrington Way	E. Bidwell Street	2576	45	100	100	97.0%	2.0%	1.0%	80.0%	15.0%	5.0%	4.77	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
	Creekside Drive	E. Bidwell Street	Oak Avenue Parkway	9582.45	45	100	100	97.0%	2.0%	1.0%	80.0%	15.0%	5.0%	4.77	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
	E. Bidwell Street	Blue Ravine Road	Oak Avenue Parkway	25069														
	Oak Avenue Parkway	E. Bidwell Street	Blue Ravine Road	19992														
	S. Lexington Drive	Oak Avenue Parkway	Silberhorn Drive	741														
	E. Bidwell Street	Oak Avenue Parkway	Scholar Way	37814														
	Silberhorn Drive	Scholar Way	S. Lexington Drive	2686														
	Scholar Way	E. Bidwell Street	Broadstone Parkway	5239														
	E. Bidwell Street	Clarksville Road	Broadstone Parkway	33267														
	Cavitt Drive	Scholar Way	Broadstone Parkway	815														
	Broadstone Parkway	E. Bidwell Street	Scholar Way	11111														
	Broadstone Parkway	E. Bidwell Street	Iron Point Road	7486														
	Clarksville Road	E. Bidwell Street	Broadstone Parkway	7480														
	E. Bidwell Street	Broadstone Parkway	Iron Point Road	40873														
	Iron Point Road	Broadstone Parkway	E. Bidwell Street	14111														
	Iron Point Road	Placerville Road	Empire Ranch Road	10608														
	E. Bidwell Street	Iron Point Road	US 50	47039														
	US 50	Prairie City Road	E. Bidwell Street	6715														
	US 50	E. Bidwell Street	Latrobe Road	37239														
	E. Bidwell Street	US 50	White Rock Road	11296														
	White Rock Road	E. Bidwell Street	Prairie City Road	12442														
	Prairie City Road	US 50	White Rock Road	11008														
	Folsom Boulevard	US 50	Iron Point Road	40215														
	Folsom Boulevard	Iron Point Road	Blue Ravine Road	42380														
	Natoma Station Drive	Folsom Boulevard	Ingersoll Way	12349														
	Iron Point Road	Folsom Boulevard	Ingersoll Way	6046														
	Ingersoll Way	Natoma Station Drive	Iron Point Road	1681														
	Natoma Station Drive	Blue Ravine Road	Coventry Court	13124														
	Blue Ravine Road	Folsom Boulevard	Prairie City Road	35746														
	Folsom Boulevard	Blue Ravine Road	Glenn Drive	34474														
	Glenn Drive	Folsom Boulevard	Sibley Street	2105														

Citation #	Citations	
1	Caltrans Technical Noise Supplement. 2009 (November). Table (5-11), Pg 5-60.	Caltrans Technical Noise Supplement. 2013 (September). Table (4-2), Pg 4-17.
2	Caltrans Technical Noise Supplement. 2009 (November). Equation (5-26), Pg 5-60.	Caltrans Technical Noise Supplement. 2013 (September). Equation (4-5), Pg 4-17.
3	Caltrans Technical Noise Supplement. 2009 (November). Equation (2-16), Pg 2-32.	FHWA 2004 TNM Version 2.5
4	Caltrans Technical Noise Supplement. 2009 (November). Equation (5-11), Pg 5-47, 48.	FHWA 2004 TNM Version 2.5
5	Caltrans Technical Noise Supplement. 2009 (November). Equation (2-26), Pg 2-55, 56.	Caltrans Technical Noise Supplement. 2013 (September). Equation (2-23), Pg 2-51, 52.
6	Caltrans Technical Noise Supplement. 2009 (November). Equation (2-27), Pg 2-57.	Caltrans Technical Noise Supplement. 2013 (September). Equation (2-24), Pg 2-53.
7	Caltrans Technical Noise Supplement. 2009 (November). Pg 2-53.	Caltrans Technical Noise Supplement. 2013 (September). Pg 2-57.
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10	Caltrans Technical Noise Supplement. 2009 (November). Equation (5-9), Pg 5-45.	FHWA 2004 TNM Version 2.5
11	Caltrans Technical Noise Supplement. 2009 (November). Equation (5-13), Pg 5-49.	FHWA 2004 TNM Version 2.5
12	Caltrans Technical Noise Supplement. 2009 (November). Equation (5-14), Pg 5-49.	FHWA 2004 TNM Version 2.5
13	Federal Highway Administration Traffic Noise Model Technical Manual. Report No. FHWA-PD-96-010. 1998 (January). Equation (16), Pg 67	
14	Federal Highway Administration Traffic Noise Model Technical Manual. Report No. FHWA-PD-96-010. 1998 (January). Equation (20), Pg 69	
15	Federal Highway Administration Traffic Noise Model Technical Manual. Report No. FHWA-PD-96-010. 1998 (January). Equation (18), Pg 69	

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Added Daily Trip Calculations

Segment	Direction needed	AADT
CARQUINEZ BRIDGE	Ahead (far lane)	144000
VALLEJO, JCT. RTE. 29 NORTH	Back (close lane)	116000
Total		**260000**

Source: https://dot.ca.gov/programs/traffic-operations/census (2021 data)

Combined noise from separate roadways Calcs

Near lane (dBA)	69.79815881
Far lane (dBA)	69.08736887
Combined	**72.46758906**

Notes:

1 - Computation of the attenuated noise level is based on the equation presented on pg. 176 and 177 of FTA 2018.

2 - Computation of the ground factor is based on the equation presentd in Table 4-26 on pg. 86 of FTA 2018, where the distance of the reference noise leve can be adjusted and the usage factor is not applied (i.e., the usage factor is equal to 1).

3 - Summation of noise levels from different stationary noise sources at the same receptor is based on the equation presented on page 201 of FTA 2018.

Sources:

Federal Transit Association (FTA). 2018 (September). Transit Noise and Vibration Impact Assessment. Washington, D.C. Available: <http://www.transit.dot.gov/sites/fta.dot.gov/files/docs/research-innovation/118131/transit-noise-and-vibration-impact-assessment-manual-fta-report-no-0123_0.pdf>Accessed: March 5, 2020.

Land Use	Existing Condidtions	Proposed Project	Noise Sources	New Operational Noise Sources	Notes	Data Request Questions	New Noise Source Summary
		PHASE 1				How much more ship activity will be seen at full buildout?	More Ship activity
Main Pier	▸Pier is approximately 30 feet wide and 262 feet long	▸Pier expansion to 420 feet in length and 50 feet wide	Construction				HVAC equipment: utility upgrades, multi use b
	▸Trestle connecting shore to the pier is approximately 20 feet wide and 202 feet long	▸Trestle widening to 30 feet wide	Construction				New Pump station
	▸Catwalk extension is approximately 4 feet wide and 204 feet long	▸Removal of 20 fender piles	Construction				Termporary Shuttle
	▸Approximately 70 piles comprise the main pier, including 20 fender piles	▸Removal of breakwater, including steel pile supported catwalk and sheet piles serving as a wave screen as well as mooring dolphins	Construction				Row house training and maintanence
		▸All 20 fender piles to be removed	Construction				Increased Human Activity at Waterfront canop
		▸Installation of 250 new piles	Construction				
		▸Installation of 4 new mooring dolphins	Construction		Mooring dolphin = marine strucutre used to secure and anchor ships		
		▸Installation of two new catwalks and one breakwater	Construction	More ship activity?			
Boat Basin 1 and Floating Docks	▸Approximately 4,500 square feet of floating dock space	▸9,500 square feet of floating dock space	Construction	More ship activity?			
	▸10 slips /berthing positions	▸23 slips/berthing positions	Construction	More ship activity?			
	▸16 guide piles comprise the floating docks	▸Installation of approximately 24 guide piles	Construction	More ship activity?			
	▸Maintenance dredging every 8-10 years of approximately 15,400 cubic yards	▸Construction of two gangways approximately 80 feet long by five feet wide and ascending four feet high	Construction	More ship activity?			
		▸60,000 cubic yards of dredged material to be excavated	Dredging				
Marine Yard	▸Approximately 0.5 acres	▸Organized to operate in a 'normal' training and education manner		Operations same as before			
	▸Hosts a number of small buildings and structures within the secured perimeter						
	▸Marine Programs and Naval Sciences modular structures are located outside the MARSEC secured perimeter of the Marine Yard						
	▸Cadets use the area within the secured perimeter to train with forklifts and ships' cranes to practice loading cargo and other provisioning activities						
Vessel	▸500-foot training vessel, TSGB	▸525 ft multi-mission vessel, NSMV	New ship	Larger ship = more noise?			
	▸151 feet tall with operating draft of 30.5 feet	▸Design draft of 21 feet 4 inches					
	▸Accommodations for 295 crew and students	▸Accommodations for 600 cadets		More students = more noise?			
		▸TSGB would be temporarily relocated and operated while the main pier is under construction in Phase One					
Utility Systems	▸Existing wastewater pump station is adequately sized in the current conditions; however, it is close to capacity	▸Upgrades to VFWD pump station including replacing/upsizing pumps and/or increasing the wet well size is not anticipated may be necessary	Install new Pump	Noisier pump station?			
	▸No known issues with the existing water conveyance system condition; no major maintenance or repair requirements are anticipated	▸Sanitary sewer expansion, manhole(s), and lift station is not anticipated but may be necessary					
	▸Stormwater treatment facilities currently do not exist for the waterfront area	▸Improvements to water conveyance system to meet fire flow and pressure requirements as well as remediation of unusually shallow pipes in some areas including replacement of lines that are too small and/or too shallow and connecting dead-end lines					
		▸Potable water line expansion out to the main pier	Installation				
		▸Improvements to existing stormwater drainage channel along Maritime Academy Drive including upsizing an existing culvert and potentially widening some portions of the channel, and reducing peak flow upstream detention	Installation				
		▸Installation of stormwater treatment facilities	Installation	Treatment facility noise? HVAC?			
		▸Upgrades to shore power transformer, switch gear, and cable management system	Installation				
		▸Upgrades to telecommunication lines					
		▸Upgrades to fire detection systems, energy management, heating/ventilation/air-conditioning, chilled water, boilers, and steam piping	Installation	More HVAC			
		▸Rerouting, and potential expansion of existing dock boiler, gas supply, and metering					
		▸Sitewide lighting upgrades					
Temporary Berth Accommodations	▸Suisun Bay Reserve Fleet	▸Suisun Bay Reserve Fleet (TSGB, Tugboat, and T-Boats)					
	▸City of Vallejo Marina	▸TSGB					
		▸Cadets would continue to receive instruction aboard the TSGB while temporarily moored at Suisun Bayduring the day, with nighttime activities limited to night watches (four cadets per watch performing three-hour shifts for a 12-hour total nighttime duration					
		▸Cal Maritime would would operate a shuttle between the main campus and temporary berth at Suisun Bay and City of Vallejo Marina to transport cadets, faculty, and staff as needed		New shuttle for increased noise on roadways			
		▸Cadets will continue to receive small vessel training at the City of Vallejo Marina.					
		PHASE 2					

Boathouse	▸Approximately 9,990 square feet ▸Overwater portion supported by approximately 10 piles ▸One large open assembly area, sail loft, 7 offices, 2 unisex restrooms, utility and equipment rooms, a break room, wood and metal workshops, and storage spaces ▸Partially enclosed boat basin ▸Three boat slips	▸Seismic upgrades including foundation improvements and installation of new structural piles ▸Interior upgrades reverting the primary entrance (or headhouse) back to original use as a sail loft, ADA compliant improvements and restroom, electrical, and plumbing system upgrades	Construction Installation	
Boat Basin 2	▸Not present in existing conditions ▸Currently open water in Morrow Cove	▸Expansion of existing boat basin by creating new 18,000-square-foot breakwater extending 450 feet offshore ▸Installation of 10,800 square feet of floating berthing area with 26 slips/berthing positions ▸Installation of approximately 30 new piles ▸Installation of 80-foot-long by 5-foot-wide aluminum gangway ascending to 4 feet in height ▸30,000 cubic yards of dredging with expanded boat basin	Construction Construction Construction Construction construction	More ship activity? More ships More ships more ships more ships
Marine Yard	▸Marine Yard area located outside the MARSEC secured perimeter ▸Cadets use the area to train with forklifts and practice loading cargo and other provisioning activities	▸Envisioned to be a pedestrian-oriented plaza ▸Serve functional activities related to the new NSMV, and contain staging, storage, and truck access ▸Landscape improvements ▸Demolition and removal of existing Marine Program and Naval Science modulars ▸Expanded to 21,680 square feet	demolition Construction	more ships
Shoreline	▸Maintained by Cal Maritime as open space and allows public access ▸Armored with rip-rap and approximately 533 stone columns for seismic integrity site densification ▸Picnic, fishing, and other park/recreation facilities are available along the shoreline ▸A portion of the Bay Trail also runs along an asphalt path paralleling the shoreline terminating near the dining hall on the west side of campus	▸Upland zone improvements including primary pedestrian path, plantings, and the upland portion of a public pier, lookout, and waterfront plaza		
		PHASE 3		
Marine Programs Multi-Use Building	▸Located in the Marine Yard, outside the MARSEC secured perimeter ▸Marine Programs modular is approximately 2,575 square feet ▸Naval Science modular is approximately 2, 279 square feet	▸Construction of a new multi-story Marine Programs Multi-Use Building set back into the hillside ▸Gross building area would be approximately 20,300 square feet ▸Lookout and harbor control tower are proposed in this area as well and would be between 50 and 60 feet in height	Construction	HVAC
Marine Hydrokinetic Barge	▸Not present in existing conditions ▸Currently open water east of TSGB	▸Would be a power barge anchored close to shore and upstream of the main pier and NSMV ▸Would provide a renewable energy source to campus of up to 10 megawatts		
Row House	▸Not present in existing conditions ▸Currently open water in Morrow Cove	▸New two-story, mixed-use, portal framed structure ▸Gross area is proposed to be approximately 10,750 square feet which includes 6,150 square feet at the first floor and 4,600 square feet at the second-floor mezzanine ▸Structure is proposed on in-water, to be placed over a floating dock system composed of high-density polyethylene cubes	Construction	Rowing Training Racing shell maintenance
Central Waterfront Esplanade & Canopy	▸Not present in existing conditions ▸Involves area at the terminus of the major campus axis connecting the main quad and extending to the new breakwater developed in Phase Two	▸Construction of a new iconic canopy structure, feature paving, fire pits, educational signage, and interactive furnishing elements ▸Canopy area would be approximately 3,780 square feet with a height of 14 feet ▸Construction of a large, stepped seating area on the western edge providing access to the water's edge at different tidal levels ▸Exterior light fixtures, integrated atmospheric misting, outdoor ceiling fans, built-in furniture, gas barbecue equipment or fire pits could also be developed	Construction	Increased human activity
Shoreline	▸Same area as Phase Two	▸Mass grading and implementation of the transition zone, intertidal zone, and living reefs ▸Transition zone improvements: landscaping improvements, construction of a secondary pedestrian path ▸Intertidal zone improvements: creation of habitat for specific species and sea level rise resilience ▸Living reef improvements: create native habitat for oyster, eel, mussels ▸Completion of over water portions of public pier and lookouts constructed in Phase Two		

Traffic Noise Spreadsheet Calculator

Project: Truckee KidZone Museum

Noise Level Descriptor:	CNEL
Site Conditions:	Hard
Traffic Input:	ADT
Traffic K-Factor:	

				Input											Output				
		Segment Description and Location				Distance to Directional Centerline, (feet)4		Traffic Distribution Characteristics							xxx ft. CNEL,	Distance to Contour, (feet)3			
Number	**Name**	**From**	**To**	**ADT**	**Speed (mph)**	**Near**	**Far**	**% Auto**	**% Medium**	**% Heavy**	**% Day**	**% Eve**	**% Night**		**(dBA)5,6,7**	**75 dBA**	**70 dBA**	**65 dBA**	**78.9 dBA**
Existing + Project Conditions																			
15	I-80			144,000	55	650	945	97.0%	2.0%	1.0%	80.0%	15.0%	5.0%		69.97	246	779	2463	100

*All modeling assumes average pavement, level roadways (less than 1.5% grade), constant traffic flow and does not account for shielding of any type or finite roadway adjustments. All levels are reported as A-weighted noise levels.

Citation #	Citations	
1	Caltrans Technical Noise Supplement. 2009 (November). Table (5-11), Pg 5-60.	Caltrans Technical Noise Supplement. 2013 (September). Table (4-2), Pg 4-17.
2	Caltrans Technical Noise Supplement. 2009 (November). Equation (5-26), Pg 5-60.	Caltrans Technical Noise Supplement. 2013 (September). Equation (4-5), Pg 4-17.
3	Caltrans Technical Noise Supplement. 2009 (November). Equation (2-16), Pg 2-32.	FHWA 2004 TNM Version 2.5
4	Caltrans Technical Noise Supplement. 2009 (November). Equation (5-11), Pg 5-47, 48.	FHWA 2004 TNM Version 2.5
5	Caltrans Technical Noise Supplement. 2009 (November). Equation (2-26), Pg 2-55, 56.	Caltrans Technical Noise Supplement. 2013 (September). Equation (2-23), Pg 2-51, 52.
6	Caltrans Technical Noise Supplement. 2009 (November). Equation (2-27), Pg 2-57.	Caltrans Technical Noise Supplement. 2013 (September). Equation (2-24), Pg 2-53.
7	Caltrans Technical Noise Supplement. 2009 (November). Pg 2-53.	Caltrans Technical Noise Supplement. 2013 (September). Pg 2-57.
8	Caltrans Technical Noise Supplement. 2009 (November). Equation (5-7), Pg 5-45.	FHWA 2004 TNM Version 2.5
9	Caltrans Technical Noise Supplement. 2009 (November). Equation (5-8), Pg 5-45.	FHWA 2004 TNM Version 2.5
10	Caltrans Technical Noise Supplement. 2009 (November). Equation (5-9), Pg 5-45.	FHWA 2004 TNM Version 2.5
11	Caltrans Technical Noise Supplement. 2009 (November). Equation (5-13), Pg 5-49.	FHWA 2004 TNM Version 2.5
12	Caltrans Technical Noise Supplement. 2009 (November). Equation (5-14), Pg 5-49.	FHWA 2004 TNM Version 2.5
13	Federal Highway Administration Traffic Noise Model Technical Manual. Report No. FHWA-PD-96-010. 1998 (January). Equation (16), Pg 67	
14	Federal Highway Administration Traffic Noise Model Technical Manual. Report No. FHWA-PD-96-010. 1998 (January). Equation (20), Pg 69	
15	Federal Highway Administration Traffic Noise Model Technical Manual. Report No. FHWA-PD-96-010. 1998 (January). Equation (18), Pg 69	

References

California Department of Transportation (Caltrans). 2009 (November). Technical Noise Supplement. Available: http://www.dot.ca.gov/hq/env/noise/pub/tens_complete.pdf. Accessed August 17, 2017.

California Department of Transportation (Caltrans). 2013 (September). Technical Noise Supplement. Available: http://www.dot.ca.gov/hq/env/noise/pub/TeNS_Sept_2013A.pdf. Accessed August 17, 2017.

Federal Highway Administration. 2004. Traffic Noise Model Version 2.5. Available: https://www.fhwa.dot.gov/environment/noise/traffic_noise_model/tnm_v25/. Accessed August 17, 2017.

Added Daily Trip Calculations

Segment	Direction needed	AADT
CARQUINEZ BRIDGE	Ahead (far lane)	144000
VALLEJO, JCT. RTE. 29 NORTH	Back (close lane)	116000
Total		**260000**

Source: https://dot.ca.gov/programs/traffic-operations/census (2021 data)

Combined noise from separate roadways Calcs

Near lane (dBA)	69.79815881
Far lane (dBA)	69.08736887
Combined	**72.46758906**

Notes:

1 - Computation of the attenuated noise level is based on the equation presented on pg. 176 and 177 of FTA 2018.

2 - Computation of the ground factor is based on the equation presentd in Table 4-26 on pg. 86 of FTA 2018, where the distance of the reference noise leve can be adjusted and the usage factor is not applied (i.e., the usage factor is equal to 1).

3 - Summation of noise levels from different stationary noise sources at the same receptor is based on the equation presented on page 201 of FTA 2018.

Sources:

Federal Transit Association (FTA). 2018 (September). Transit Noise and Vibration Impact Assessment. Washington, D.C. Available: <http://www.transit.dot.gov/sites/fta.dot.gov/files/docs/research-innovation/118131/transit-noise-and-vibration-impact-assessment-manual-fta-report-no-0123_0.pdf>Accessed: March 5, 2020.

Land Use	Existing Condidtions	Proposed Project	Noise Sources	New Operational Noise Sources	Notes	Data Request Questions	New Noise Source Summary
PHASE 1						How much more ship activity will be seen at full buildout?	More Ship activity
Main Pier	▸Pier is approximately 30 feet wide and 262 feet long	▸Pier expansion to 420 feet in length and 50 feet wide	Construction				HVAC equipment: utility upgrades, multi use building
	▸Trestle connecting shore to the pier is approximately 20 feet wide and 202 feet long	▸Trestle widening to 30 feet wide	Construction				New Pump station
	▸Catwalk extension is approximately 4 feet wide and 204 feet long	▸Removal of 20 fender piles	Construction				Termporary Shuttle
	▸Approximately 70 piles comprise the main pier, including 20 fender piles	▸Removal of breakwater, including steel pile supported catwalk and sheet piles serving as a wave screen as well as mooring dolphins	Construction				Row house training and maintanence
		▸All 20 fender piles to be removed	Construction				Increased Human Activity at Waterfront canopy
		▸Installation of 250 new piles	Construction				
		▸Installation of 4 new mooring dolphins	Construction		Mooring dolphin = marine strucutre used to secure and anchor ships		
		▸Installation of two new catwalks and one breakwater	Construction	More ship activity?			
Boat Basin 1 and Floating Docks	▸Approximately 4,500 square feet of floating dock space	▸9,500 square feet of floating dock space	Construction	More ship activity?			
	▸10 slips /berthing positions	▸23 slips/berthing positions	Construction	More ship activity?			
	▸16 guide piles comprise the floating docks	▸Installation of approximately 24 guide piles	Construction	More ship activity?			
	▸Maintenance dredging every 8-10 years of approximately 15,400 cubic yards	▸Construction of two gangways approximately 80 feet long by five feet wide and ascending four feet high	Construction	More ship activity?			
		▸60,000 cubic yards of dredged material to be excavated	Dredging				
Marine Yard	▸Approximately 0.5 acres	▸Organized to operate in a 'normal' training and education manner		Operations same as before			
	▸Hosts a number of small buildings and structures within the secured perimeter						
	▸Marine Programs and Naval Sciences modular structures are located outside the MARSEC secured perimeter of the Marine Yard						
	▸Cadets use the area within the secured perimeter to train with forklifts and ships' cranes to practice loading cargo and other provisioning activities						
Vessel	▸500-foot training vessel, TSGB	▸525 ft multi-mission vessel, NSMV	New ship	Larger ship = more noise?			
	▸151 feet tall with operating draft of 30.5 feet	▸Design draft of 21 feet 4 inches					
	▸Accommodations for 295 crew and students	▸Accommodations for 600 cadets		More students = more noise?			
		▸TSGB would be temporarily relocated and operated while the main pier is under construction in Phase One					
Utility Systems	▸Existing wastewater pump station is adequately sized in the current conditions; however, it is close to capacity	▸Upgrades to VFWD pump station including replacing/upsizing pumps and/or increasing the wet well size is not anticipated may be necessary	Install new Pump	Noisier pump station?			
	▸No known issues with the existing water conveyance system condition; no major maintenance or repair requirements are anticipated	▸Sanitary sewer expansion, manhole(s), and lift station is not anticipated but may be necessary					
	▸Stormwater treatment facilities currently do not exist for the waterfront area	▸Improvements to water conveyance system to meet fire flow and pressure requirements as well as remediation of unusually shallow pipes in some areas including replacement of lines that are too small and/or too shallow and connecting dead-end lines					
		▸Potable water line expansion out to the main pier	Installation				
		▸Improvements to existing stormwater drainage channel along Maritime Academy Drive including upsizing an existing culvert and potentially widening some portions of the channel, and reducing peak flow upstream detention	Installation				
		▸Installation of stormwater treatment facilities	Installation	Treatment facility noise? HVAC?			
		▸Upgrades to shore power transformer, switch gear, and cable management system	Installation				
		▸Upgrades to telecommunication lines					
		▸Upgrades to fire detection systems, energy management, heating/ventilation/air-conditioning, chilled water, boilers, and steam piping	Installation	More HVAC			
		▸Rerouting, and potential expansion of existing dock boiler, gas supply, and metering					
		▸Sitewide lighting upgrades					
Temporary Berth Accommodations	▸Suisun Bay Reserve Fleet	▸Suisun Bay Reserve Fleet (TSGB, Tugboat, and T-Boats)					
	▸City of Vallejo Marina	▸TSGB					
		▸Cadets would continue to receive instruction aboard the TSGB while temporarily moored at Suisun Bayduring the day, with nighttime activities limited to night watches (four cadets per watch performing three-hour shifts for a 12-hour total nighttime duration					
		▸Cal Maritime would would operate a shuttle between the main campus and temporary berth at Suisun Bay and City of Vallejo Marina to transport cadets, faculty, and staff as needed		New shuttle for increased noise on roadways			
		▸Cadets will continue to receive small vessel training at the City of Vallejo Marina.					
PHASE 2							

Boathouse	▸Approximately 9,990 square feet ▸Overwater portion supported by approximately 10 piles ▸One large open assembly area, sail loft, 7 offices, 2 unisex restrooms, utility and equipment rooms, a break room, wood and metal workshops, and storage spaces ▸Partially enclosed boat basin ▸Three boat slips	▸Seismic upgrades including foundation improvements and installation of new structural piles ▸Interior upgrades reverting the primary entrance (or headhouse) back to original use as a sail loft, ADA compliant improvements and restroom, electrical, and plumbing system upgrades	Construction Installation	
Boat Basin 2	▸Not present in existing conditions ▸Currently open water in Morrow Cove	▸Expansion of existing boat basin by creating new 18,000-square-foot breakwater extending 450 feet offshore ▸Installation of 10,800 square feet of floating berthing area with 26 slips/berthing positions ▸Installation of approximately 30 new piles ▸Installation of 80-foot-long by 5-foot-wide aluminum gangway ascending to 4 feet in height ▸30,000 cubic yards of dredging with expanded boat basin	Construction Construction Construction Construction construction	More ship activity? More ships More ships more ships more ships
Marine Yard	▸Marine Yard area located outside the MARSEC secured perimeter ▸Cadets use the area to train with forklifts and practice loading cargo and other provisioning activities	▸Envisioned to be a pedestrian-oriented plaza ▸Serve functional activities related to the new NSMV, and contain staging, storage, and truck access ▸Landscape improvements ▸Demolition and removal of existing Marine Program and Naval Science modulars ▸Expanded to 21,680 square feet	demolition Construction	more ships
Shoreline	▸Maintained by Cal Maritime as open space and allows public access ▸Armored with rip-rap and approximately 533 stone columns for seismic integrity site densification ▸Picnic, fishing, and other park/recreation facilities are available along the shoreline ▸A portion of the Bay Trail also runs along an asphalt path paralleling the shoreline terminating near the dining hall on the west side of campus	▸Upland zone improvements including primary pedestrian path, plantings, and the upland portion of a public pier, lookout, and waterfront plaza		
PHASE 3				
Marine Programs Multi-Use Building	▸Located in the Marine Yard, outside the MARSEC secured perimeter ▸Marine Programs modular is approximately 2.575 square feet ▸Naval Science modular is approximately 2, 279 square feet	▸Construction of a new multi-story Marine Programs Multi-Use Building set back into the hillside ▸Gross building area would be approximately 20,300 square feet ▸Lookout and harbor control tower are proposed in this area as well and would be between 50 and 60 feet in height	Construction	HVAC
Marine Hydrokinetic Barge	▸Not present in existing conditions ▸Currently open water east of TSGB	▸Would be a power barge anchored close to shore and upstream of the main pier and NSMV ▸Would provide a renewable energy source to campus of up to 10 megawatts		
Row House	▸Not present in existing conditions ▸Currently open water in Morrow Cove	▸New two-story, mixed-use, portal framed structure ▸Gross area is proposed to be approximately 10,750 square feet which includes 6,150 square feet at the first floor and 4,600 square feet at the second-floor mezzanine ▸Structure is proposed on in-water, to be placed over a floating dock system composed of high-density polyethylene cubes	Construction	Rowing Training Racing shell maintenance
Central Waterfront Esplanade & Canopy	▸Not present in existing conditions ▸Involves area at the terminus of the major campus axis connecting the main quad and extending to the new breakwater developed in Phase Two	▸Construction of a new iconic canopy structure, feature paving, fire pits, educational signage, and interactive furnishing elements ▸Canopy area would be approximately 3,780 square feet with a height of 14 feet ▸Construction of a large, stepped seating area on the western edge providing access to the water's edge at different tidal levels ▸Exterior light fixtures, integrated atmospheric misting, outdoor ceiling fans, built-in furniture, gas barbecue equipment or fire pits could also be developed	Construction	Increased human activity
Shoreline	▸Same area as Phase Two	▸Mass grading and implementation of the transition zone, intertidal zone, and living reefs ▸Transition zone improvements: landscaping improvements, construction of a secondary pedestrian path ▸Intertidal zone improvements: creation of habitat for specific species and sea level rise resilience ▸Living reef improvements: create native habitat for oyster, eel, mussels ▸Completion of over water portions of public pier and lookouts constructed in Phase Two		

Cal State Maritime Phase 1 (Marine Yard)

Location	Distance to Nearest Receptor in feet	Combined Predicted Noise Level (L_{eq} dBA)
threshold	490	65.0
Lower Residences Dorms	1330	56.3
Upper Residence Dorms	1470	55.5
Staff Housing	1810	53.6
NorthWest Residence	2060	52.5
Eastern Residence	1600	54.7
Campus Library	870	60.0
Campus Labs	630	62.8

Equipment	Reference Emission Noise Levels (L_{max}) at 50 feet[1]	Usage Factor[1]
Crane	85	0.16
Excavator	85	0.4
Concrete Mixer Truck	85	0.4

Ground Type	hard
Source Height	8
Receiver Height	5
Ground Factor[2]	0.00

Predicted Noise Level [3]	L_{eq} dBA at 50 feet[3]
Crane	77.0
Excavator	81.0
Concrete Mixer Truck	81.0

Combined Predicted Noise Level (L_{eq} dBA at 50 feet)
84.8

Sources:

[1] Obtained from the FHWA Roadway Construction Noise Model, January 2006. Table 1.

[2] Based on Figure 6-5 from the Federal Transit Noise and Vibration Impact Assessment, 2006 (pg 6-23).

[3] Based on the following from the Federal Transit Noise and Vibration Impact Assessment, 2006 (pg 12-3).

L_{eq}(equip) = E.L.+10*log (U.F.) - 20*log (D/50) - 10*G*log (D/50)

Where: E.L. = Emission Level;

U.F.= Usage Factor;

G = Constant that accounts for topography and ground effects (FTA 2006: pg 6-23); and

D = Distance from source to receiver.

Cal State Maritime Phase 1 (Pier)

Location	Distance to Nearest Receptor in feet	Combined Predicted Noise Level (L_{eq} dBA)
threshold	546	65.0
Lower Residences Dorms	1300	57.5
Upper Residence Dorms	1450	56.5
Staff Housing	1815	54.6
NorthWest Residence	1920	54.1
Eastern Residence	1965	53.9
Campus Library	860	61.1
Campus Labs	725	62.5

Equipment	Reference Emission Noise Levels (L_{max}) at 50 feet[1]	Usage Factor[1]
Crane	85	0.16
Tugboat	87	0.4
Concrete Mixer Truck	85	0.4

Ground Type	hard
Source Height	8
Receiver Height	5
Ground Factor[2]	0.00

Predicted Noise Level [3]	L_{eq} dBA at 50 feet[3]
Crane	77.0
Tugboat	83.0
Concrete Mixer Truck	81.0

Combined Predicted Noise Level (L_{eq} dBA at 50 feet)
85.8

Sources:

[1] Obtained from the FHWA Roadway Construction Noise Model, January 2006. Table 1.

[2] Based on Figure 6-5 from the Federal Transit Noise and Vibration Impact Assessment, 2006 (pg 6-23).

[3] Based on the following from the Federal Transit Noise and Vibration Impact Assessment, 2006 (pg 12-3).

L_{eq}(equip) = E.L.+10*log (U.F.) - 20*log (D/50) - 10*G*log (D/50)

Where: E.L. = Emission Level;

U.F.= Usage Factor;

G = Constant that accounts for topography and ground effects (FTA 2006: pg 6-23); and

D = Distance from source to receiver.

Cal State Maritime Phase 2 (Marine/Naval)

Location	Distance to Nearest Receptor in feet	Combined Predicted Noise Level (L_{eq} dBA)
threshold	490	65.0
Lower Residences Dorms	810	60.6
Upper Residence Dorms	955	59.2
Staff Housing	1300	56.5
NorthWest Residence	1540	55.1
Eastern Residence	1925	53.1
Campus Library	365	67.6
Campus Labs	255	70.7

Equipment	Reference Emission Noise Levels (L_{max}) at 50 feet[1]	Usage Factor[1]
Crane	85	0.16
Excavator	85	0.4
Dozer	85	0.4

Ground Type	hard
Source Height	8
Receiver Height	5
Ground Factor[2]	0.00

Predicted Noise Level [3]	L_{eq} dBA at 50 feet[3]
Crane	77.0
Excavator	81.0
Dozer	81.0

Combined Predicted Noise Level (L_{eq} dBA at 50 feet)
84.8

Sources:

[1] Obtained from the FHWA Roadway Construction Noise Model, January 2006. Table 1.

[2] Based on Figure 6-5 from the Federal Transit Noise and Vibration Impact Assessment, 2006 (pg 6-23).

[3] Based on the following from the Federal Transit Noise and Vibration Impact Assessment, 2006 (pg 12-3).

L_{eq}(equip) = E.L.+10*log (U.F.) - 20*log (D/50) - 10*G*log (D/50)

Where: E.L. = Emission Level;

U.F.= Usage Factor;

G = Constant that accounts for topography and ground effects (FTA 2006: pg 6-23); and

D = Distance from source to receiver.

Cal State Maritime, Phase 3 (New Building)

Location	Distance to Nearest Receptor in feet	Combined Predicted Noise Level (L_{eq} dBA)
threshold	275	70.0
Lower Residences Dorms	1215	57.1
Upper Residence Dorms	1360	56.1
Staff Housing	1695	54.2
NorthWest Residence	1970	52.9
Eastern Residence	1615	54.6
Campus Library	760	61.2
Campus Labs	520	64.5

Equipment	Reference Emission Noise Levels (L_{max}) at 50 feet[1]	Usage Factor[1]
Excavator	85	0.4
Dozer	85	0.4
Crane	85	0.16

Ground Type	hard
Source Height	8
Receiver Height	5
Ground Factor[2]	0.00

Predicted Noise Level [3]	L_{eq} dBA at 50 feet[3]
Excavator	81.0
Dozer	81.0
Crane	77.0

Combined Predicted Noise Level (L_{eq} dBA at 50 feet)
84.8

Sources:

[1] Obtained from the FHWA Roadway Construction Noise Model, January 2006. Table 1.

[2] Based on Figure 6-5 from the Federal Transit Noise and Vibration Impact Assessment, 2006 (pg 6-23).

[3] Based on the following from the Federal Transit Noise and Vibration Impact Assessment, 2006 (pg 12-3).

L_{eq}(equip) = E.L.+10*log (U.F.) - 20*log (D/50) - 10*G*log (D/50)

Where: E.L. = Emission Level;

U.F.= Usage Factor;

G = Constant that accounts for topography and ground effects (FTA 2006: pg 6-23); and

D = Distance from source to receiver.

Cal State Maritime, Phase 3 (Dredging)

Location	Distance to Nearest Receptor in feet	Combined Predicted Noise Level (L_{eq} dBA)
threshold	802	60.0
Lower Residences Dorms	550	63.3
Upper Residence Dorms	700	61.2
Staff Housing	1070	57.5
NorthWest Residence	1225	56.3
Eastern Residence	2200	51.2
Campus Library	170	73.5
Campus Labs	725	60.9

Equipment	Reference Emission Noise Levels (L_{max}) at 50 feet[1]	Usage Factor[1]
Crane	85	0.16
Workboat	72	0.4
Tugboat	87	0.4

Ground Type	hard
Source Height	8
Receiver Height	5
Ground Factor[2]	0.00

Predicted Noise Level [3]	L_{eq} dBA at 50 feet[3]
Crane	77.0
Workboat	68.0
Tugboat	83.0

Combined Predicted Noise Level (L_{eq} dBA at 50 feet)
84.1

Sources:

[1] Obtained from the FHWA Roadway Construction Noise Model, January 2006. Table 1.

[2] Based on Figure 6-5 from the Federal Transit Noise and Vibration Impact Assessment, 2006 (pg 6-23).

[3] Based on the following from the Federal Transit Noise and Vibration Impact Assessment, 2006 (pg 12-3).

L_{eq}(equip) = E.L.+10*log (U.F.) - 20*log (D/50) - 10*G*log (D/50)

Where: E.L. = Emission Level;

U.F.= Usage Factor;

G = Constant that accounts for topography and ground effects (FTA 2006: pg 6-23); and

D = Distance from source to receiver.

Cal State Maritime Operational Pumps

Location	Distance to Nearest Receptor in feet	Combined Predicted Noise Level (L_{eq} dBA)
threshold	1,371	50.0
Lower Residences Dorms	1430	49.6
Upper Residence Dorms	1550	48.9
Staff Housing	1945	47.0
NorthWest Residence	2160	46.1
Eastern Residence	1530	49.0
Campus Library	950	53.2
Campus Labs	700	55.8

Equipment	Reference Emission Noise Levels (L_{max}) at 50 feet[1]	Usage Factor[1]
Pumps	77	0.5
Pumps	77	0.5
Pumps	77	0.5

Ground Type	hard
Source Height	8
Receiver Height	5
Ground Factor[2]	0.00

Predicted Noise Level [3]	L_{eq} dBA at 50 feet[3]
Pumps	74.0
Pumps	74.0
Pumps	74.0

Combined Predicted Noise Level (L_{eq} dBA at 50 feet)
78.8

Sources:

[1] Obtained from the FHWA Roadway Construction Noise Model, January 2006. Table 1.

[2] Based on Figure 6-5 from the Federal Transit Noise and Vibration Impact Assessment, 2006 (pg 6-23).

[3] Based on the following from the Federal Transit Noise and Vibration Impact Assessment, 2006 (pg 12-3).

L_{eq}(equip) = E.L.+10*log (U.F.) - 20*log (D/50) - 10*G*log (D/50)

Where: E.L. = Emission Level;

U.F.= Usage Factor;

G = Constant that accounts for topography and ground effects (FTA 2006: pg 6-23); and

D = Distance from source to receiver.

Cal State Maritime Phase 1 (Marine Yard)

Location	Distance to Nearest Receptor in feet	Combined Predicted Noise Level (L_{eq} dBA)
threshold	866	65.0
Lower Residences Dorms	1330	61.3
Upper Residence Dorms	1470	60.4
Staff Housing	1810	58.6
NorthWest Residence	2060	57.5
Eastern Residence	1600	59.7
Campus Library	870	65.0
Campus Labs	630	67.8

Equipment	Reference Emission Noise Levels (L_{max}) at 50 feet[1]	Usage Factor[1]
Crane	85	1
Excavator	85	1
Concrete Mixer Truck	85	1

Ground Type	hard
Source Height	8
Receiver Height	5
Ground Factor[2]	0.00

Predicted Noise Level [3]	L_{eq} dBA at 50 feet[3]
Crane	85.0
Excavator	85.0
Concrete Mixer Truck	85.0

Combined Predicted Noise Level (L_{eq} dBA at 50 feet)
89.8

Sources:

[1] Obtained from the FHWA Roadway Construction Noise Model, January 2006. Table 1.

[2] Based on Figure 6-5 from the Federal Transit Noise and Vibration Impact Assessment, 2006 (pg 6-23).

[3] Based on the following from the Federal Transit Noise and Vibration Impact Assessment, 2006 (pg 12-3).

L_{eq}(equip) = E.L.+10*log (U.F.) - 20*log (D/50) - 10*G*log (D/50)

Where: E.L. = Emission Level;

U.F.= Usage Factor;

G = Constant that accounts for topography and ground effects (FTA 2006: pg 6-23); and

D = Distance from source to receiver.

Cal State Maritime Phase 1 (Pier)

Location	Distance to Nearest Receptor in feet	Combined Predicted Noise Level (L_{eq} dBA)
threshold	947	65.0
Lower Residences Dorms	1300	62.2
Upper Residence Dorms	1450	61.3
Staff Housing	1815	59.3
NorthWest Residence	1920	58.9
Eastern Residence	1965	58.7
Campus Library	860	65.8
Campus Labs	725	67.3

Equipment	Reference Emission Noise Levels (L_{max}) at 50 feet[1]	Usage Factor[1]
Crane	85	1
Tugboat	87	1
Concrete Mixer Truck	85	1

Ground Type	hard
Source Height	8
Receiver Height	5
Ground Factor[2]	0.00

Predicted Noise Level [3]	L_{eq} dBA at 50 feet[3]
Crane	85.0
Tugboat	87.0
Concrete Mixer Truck	85.0

Combined Predicted Noise Level (L_{eq} dBA at 50 feet)

90.5

Sources:

[1] Obtained from the FHWA Roadway Construction Noise Model, January 2006. Table 1.

[2] Based on Figure 6-5 from the Federal Transit Noise and Vibration Impact Assessment, 2006 (pg 6-23).

[3] Based on the following from the Federal Transit Noise and Vibration Impact Assessment, 2006 (pg 12-3).

L_{eq}(equip) = E.L.+10*log (U.F.) - 20*log (D/50) - 10*G*log (D/50)

Where: E.L. = Emission Level;

U.F.= Usage Factor;

G = Constant that accounts for topography and ground effects (FTA 2006: pg 6-23); and

D = Distance from source to receiver.

Cal State Maritime Phase 2 (Marine/Naval)

Location	Distance to Nearest Receptor in feet	Combined Predicted Noise Level (L_{eq} dBA)
threshold	866	65.0
Lower Residences Dorms	810	65.6
Upper Residence Dorms	955	64.2
Staff Housing	1300	61.5
NorthWest Residence	1540	60.0
Eastern Residence	1925	58.1
Campus Library	365	72.5
Campus Labs	255	75.6

Equipment	Reference Emission Noise Levels (L_{max}) at 50 feet[1]	Usage Factor[1]
Crane	85	1
Excavator	85	1
Dozer	85	1

Ground Type	hard
Source Height	8
Receiver Height	5
Ground Factor[2]	0.00

Predicted Noise Level [3]	L_{eq} dBA at 50 feet[3]
Crane	85.0
Excavator	85.0
Dozer	85.0

Combined Predicted Noise Level (L_{eq} dBA at 50 feet)
89.8

Sources:

[1] Obtained from the FHWA Roadway Construction Noise Model, January 2006. Table 1.

[2] Based on Figure 6-5 from the Federal Transit Noise and Vibration Impact Assessment, 2006 (pg 6-23).

[3] Based on the following from the Federal Transit Noise and Vibration Impact Assessment, 2006 (pg 12-3).

L_{eq}(equip) = E.L.+10*log (U.F.) - 20*log (D/50) - 10*G*log (D/50)

Where: E.L. = Emission Level;

U.F.= Usage Factor;

G = Constant that accounts for topography and ground effects (FTA 2006: pg 6-23); and

D = Distance from source to receiver.

Cal State Maritime, Phase 3 (New Building)

ASCENT

Location	Distance to Nearest Receptor in feet	Combined Predicted Noise Level (L_{eq} dBA)
threshold	487	70.0
Lower Residences Dorms	1215	62.1
Upper Residence Dorms	1360	61.1
Staff Housing	1695	59.2
NorthWest Residence	1970	57.9
Eastern Residence	1615	59.6
Campus Library	760	66.1
Campus Labs	520	69.4

Equipment	Reference Emission Noise Levels (L_{max}) at 50 feet[1]	Usage Factor[1]
Excavator	85	1
Dozer	85	1
Crane	85	1

Ground Type	hard
Source Height	8
Receiver Height	5
Ground Factor[2]	0.00

Predicted Noise Level [3]	L_{eq} dBA at 50 feet[3]
Excavator	85.0
Dozer	85.0
Crane	85.0

Combined Predicted Noise Level (L_{eq} dBA at 50 feet)
89.8

Sources:

[1] Obtained from the FHWA Roadway Construction Noise Model, January 2006. Table 1.

[2] Based on Figure 6-5 from the Federal Transit Noise and Vibration Impact Assessment, 2006 (pg 6-23).

[3] Based on the following from the Federal Transit Noise and Vibration Impact Assessment, 2006 (pg 12-3).

L_{eq}(equip) = E.L.+10*log (U.F.) - 20*log (D/50) - 10*G*log (D/50)

Where: E.L. = Emission Level;

U.F.= Usage Factor;

G = Constant that accounts for topography and ground effects (FTA 2006: pg 6-23); and

D = Distance from source to receiver.

Cal State Maritime, Phase 3 (Dredging)

Location	Distance to Nearest Receptor in feet	Combined Predicted Noise Level (L_{eq} dBA)
threshold	1,443	60.0
Lower Residences Dorms	550	68.4
Upper Residence Dorms	700	66.3
Staff Housing	1070	62.6
NorthWest Residence	1225	61.4
Eastern Residence	2200	56.3
Campus Library	170	78.6
Campus Labs	725	66.0

Equipment	Reference Emission Noise Levels (L_{max}) at 50 feet[1]	Usage Factor[1]
Crane	85	1
Workboat	72	1
Tugboat	87	1

Ground Type	hard
Source Height	8
Receiver Height	5
Ground Factor[2]	0.00

Predicted Noise Level [3]	L_{eq} dBA at 50 feet[3]
Crane	85.0
Workboat	72.0
Tugboat	87.0

Combined Predicted Noise Level (L_{eq} dBA at 50 feet)
89.2

Sources:

[1] Obtained from the FHWA Roadway Construction Noise Model, January 2006. Table 1.

[2] Based on Figure 6-5 from the Federal Transit Noise and Vibration Impact Assessment, 2006 (pg 6-23).

[3] Based on the following from the Federal Transit Noise and Vibration Impact Assessment, 2006 (pg 12-3).

L_{eq}(equip) = E.L.+10*log (U.F.) - 20*log (D/50) - 10*G*log (D/50)

Where: E.L. = Emission Level;

U.F.= Usage Factor;

G = Constant that accounts for topography and ground effects (FTA 2006: pg 6-23); and

D = Distance from source to receiver.

Construction Phase	Receptor	Distance	Noise Level	Noise Level (Lmax)
	Lower Res Hall	1330	56.3	61.3
	Upper Res Hall	1470	55.5	60.4
	Staff Housing	1810	53.6	58.6
Phase 1 Marine Yard	NW Res	2060	52.5	57.5
	East Res	1600	54.7	59.7
	Library	870	60.0	65.0
	Lab	630	62.8	67.8
	Lower Res Hall	1300	57.5	62.2
	Upper Res Hall	1450	56.5	61.3
	Staff Housing	1815	54.6	59.3
Phase 1 Pier	NW Res	1920	54.1	58.9
	East Res	1965	53.9	58.7
	Library	860	61.1	65.8
	Lab	725	62.5	67.3
	Lower Res Hall	810	60.6	65.6
	Upper Res Hall	955	59.2	64.2
	Staff Housing	1300	56.5	61.5
2 Naval Modulars	NW Res	1540	55.1	60.0
	East Res	1925	53.1	58.1
	Library	365	67.6	72.5
	Lab	255	70.7	75.6
	Lower Res Hall	1215	57.1	62.1
	Upper Res Hall	1360	56.1	61.1
	Staff Housing	1695	54.2	59.2
3 (New Building)	NW Res	1970	52.9	57.9
	East Res	1615	54.6	59.6
	Library	760	61.2	66.1
	Lab	520	64.5	69.4
	Lower Res Hall	550	63.3	68.4
	Upper Res Hall	700	61.2	66.3
	Staff Housing	1070	57.5	62.6
3 (Dredging)	NW Res	1225	**56.3**	**61.4**
	East Res	2200	51.2	56.3
	Library	170	73.5	78.6
	Lab	725	60.9	66.0
	Lower Res Hall	1430	49.6	
	Upper Res Hall	1560	48.9	
	Staff Housing	1945	47.0	
Operational Pumps	NW Res	2160	46.1	
	East Res	1530	49.0	
	Library	950	53.2	
	Lab	700	55.8	

Equipment Description	Acoustical Usage Factor (%)	Spec 721.560 Lmax @ 50ft (dBA slow)	Actual Measured Lmax @ 50ft (dBA slow)	No. of Actual Data Samples (count)	Spec 721.560 LmaxCalc	Spec 721.560 Leq	Distance	Actual Measured LmaxCalc	Actual Measured Leq
Auger Drill Rig	20	85	84	36	79.0	72.0	100	78.0	71.0
Backhoe	40	80	78	372	74.0	70.0	100	72.0	68.0
Bar Bender	20	80	na	0	74.0	67.0	100		
Blasting	na	94	na	0	88.0		100		
Boring Jack Power Unit	50	80	83	1	74.0	71.0	100	77.0	74.0
Chain Saw	20	85	84	46	79.0	72.0	100	78.0	71.0
Clam Shovel (dropping)	20	93	87	4	87.0	80.0	100	81.0	74.0
Compactor (ground)	20	80	83	57	74.0	67.0	100	77.0	70.0
Compressor (air)	40	80	78	18	74.0	70.0	100	72.0	68.0
Concrete Batch Plant	15	83	na	0	77.0	68.7	100		
Concrete Mixer Truck	40	85	79	40	79.0	75.0	100	73.0	69.0
Concrete Pump Truck	20	82	81	30	76.0	69.0	100	75.0	68.0
Concrete Saw	20	90	90	55	84.0	77.0	100	84.0	77.0
Crane	16	85	81	405	79.0	71.0	100	75.0	67.0
Dozer	40	85	82	55	79.0	75.0	100	76.0	72.0
Drill Rig Truck	20	84	79	22	78.0	71.0	100	73.0	66.0
Drum Mixer	50	80	80	1	74.0	71.0	100	74.0	71.0
Dump Truck	40	84	76	31	78.0	74.0	100	70.0	66.0
Excavator	40	85	81	170	79.0	75.0	100	75.0	71.0
Flat Bed Truck	40	84	74	4	78.0	74.0	100	68.0	64.0
Front End Loader	40	80	79	96	74.0	70.0	100	73.0	69.0
Generator	50	82	81	19	76.0	73.0	100	75.0	72.0
Generator (<25KVA, VMS s	50	70	73	74	64.0	61.0	100	67.0	64.0
Gradall	40	85	83	70	79.0	75.0	100	77.0	73.0
Grader	40	85	na	0	79.0	75.0	100		
Grapple (on Backhoe)	40	85	87	1	79.0	75.0	100	81.0	77.0
Horizontal Boring Hydr. Jac	25	80	82	6	74.0	68.0	100	76.0	70.0
Hydra Break Ram	10	90	na	0	84.0	74.0	100		
Impact Pile Driver	20	95	101	11	89.0	82.0	100	95.0	88.0
Jackhammer	20	85	89	133	79.0	72.0	100	83.0	76.0
Man Lift	20	85	75	23	79.0	72.0	100	69.0	62.0
Mounted Impact Hammer	20	90	90	212	84.0	77.0	100	84.0	77.0
Pavement Scarafier	20	85	90	2	79.0	72.0	100	84.0	77.0
Paver	50	85	77	9	79.0	76.0	100	71.0	68.0
Pickup Truck	40	55	75	1	49.0	45.0	100	69.0	65.0
Pneumatic Tools	50	85	85	90	79.0	76.0	100	79.0	76.0
Pumps	50	77	81	17	71.0	68.0	100	75.0	72.0
Refrigerator Unit	100	82	73	3	76.0	76.0	100	67.0	67.0
Rivit Buster/chipping gun	20	85	79	19	79.0	72.0	100	73.0	66.0
Rock Drill	20	85	81	3	79.0	72.0	100	75.0	68.0
Roller	20	85	80	16	79.0	72.0	100	74.0	67.0
Sand Blasting (Single Nozzl	20	85	96	9	79.0	72.0	100	90.0	83.0
Scraper	40	85	84	12	79.0	75.0	100	78.0	74.0
Shears (on backhoe)	40	85	96	5	79.0	75.0	100	90.0	86.0
Slurry Plant	100	78	78	1	72.0	72.0	100	72.0	72.0
Slurry Trenching Machine	50	82	80	75	76.0	73.0	100	74.0	71.0
Soil Mix Drill Rig	50	80	na	0	74.0	71.0	100		
Tractor	40	84	na	0	78.0	74.0	100		
Tugboat	40	87	74	4	81.0	77.0	100	68.0	64.0
Vacuum Excavator (Vac-tru	40	85	85	149	79.0	75.0	100	79.0	75.0
Vacuum Street Sweeper	10	80	82	19	74.0	64.0	100	76.0	66.0
Ventilation Fan	100	85	79	13	79.0	79.0	100	73.0	73.0
Vibrating Hopper	50	85	87	1	79.0	76.0	100	81.0	78.0
Vibratory Concrete Mixer	20	80	80	1	74.0	67.0	100	74.0	67.0
Vibratory Pile Driver	20	95	101	44	89.0	82.0	100	95.0	88.0
Warning Horn	5	85	83	12	79.0	66.0	100	77.0	64.0
Workboat	40	72	74	4	66.0	62.0	100	68.0	64.0
Welder / Torch	40	73	74	5	67.0	63.0	100	68.0	64.0

Source:
FHWA Roadway Construction Noise Model, January 2006. Table 9.1
U.S. Department of Transportation
CA/T Construction Spec. 721.560

Addition of Noise Levels from Multiple Sources at a Discrete Receptor

OBJECTIVE: This work sheet is designed to estiamte the combined level of noise exposure at a single discrete receptor from multiple point sources.

KEY: Orange cells are for input.

Grey cells are intermediate calculations performed by the model.

Green cells are data to present in a written analysis (output).

Receptor Name: **Houses on Fostoria Street, North of the project site**

STEP 1: Identify the noise sources and enter the reference noise levels (dBA and distance).

Hour of Day (24-HR time)

STEP 3: Select the distance to the receptor and the reduction provided by any intervening barrier.

Step 1.				Step 2.				Step 3.				
Noise Source	**Reference Noise Level**			**Attenuation Characteristics**				**Attenuated Noise Level at Receptor**				
	Reference Noise Level (dBA)	@	Reference Distance (ft)	Ground Type (soft/hard)	Source Height (ft)	Receiver Height (ft)	Ground Factor		Noise Level (dBA)	@	Distance to Receptor (ft)	Reduction Provided by Barrier, if any (dBA)
HVAC Unit	78.0	@	3	hard	35	5	0.00		78.0	@	3	0
HVAC Unit	78.0	@	3	hard	35	5	0.00		78.0	@	3	0
							0.66					
							0.66					
							0.66					

Combined level of noise exposure at receptor from all noise sources (dBA): **81.0**

Computation of the attenuated noise level is based on the equation presented on pg. 12-3 and 12-4 of FTA 2006.

Computation of the ground factor is based on the equation presentd in Figure 6-23 on pg. 6-23 of FTA 2006, where the distance of the reference noise leve can be adjusted and the usage factor is not applied (i.e., the usage factor is equal to 1).

Summation of noise levels from different stationary noise sources at the same receptor is based on the equation presented on page 2-3 of FTA 2006.

Sources:

Federal Transit Association (FTA). 2006 (May). Transit Noise and Vibration Impact Assessment. FTA-VA-90-1003-06. Washington, D.C. Available: <http://www.fta.dot.gov/documents/FTA_Noise_and_Vibration_Manual.pdf>. Accessed: March 5, 2020.

Addition of Noise Levels from Multiple Sources at a Discrete Receptor

OBJECTIVE: This work sheet is designed to estiamte the combined level of noise exposure at a single discrete receptor from multiple point sources.

KEY: Orange cells are for input.

Grey cells are intermediate calculations performed by the model.

Green cells are data to present in a written analysis (output).

Receptor Name: **Houses on Fostoria Street, North of the project site**

STEP 1: Identify the noise sources and enter the reference noise levels (dBA and distance).

Hour of Day (24-HR time)

STEP 3: Select the distance to the receptor and the reduction provided by any intervening barrier.

Step 1.				Step 2.				Step 3.			
Noise Source	**Reference Noise Level**			**Attenuation Characteristics**				**Attenuated Noise Level at Receptor**			
	Reference Noise Level (dBA)	@	Reference Distance (ft)	Ground Type (soft/hard)	Source Height (ft)	Receiver Height (ft)	Ground Factor	Noise Level (dBA)	@	Distance to Receptor (ft)	Reduction Provided by Barrier, if any (dBA)
HVAC Unit	78.0	@	3	hard	35	5	0.00	31	@	650	0
HVAC Unit	78.0	@	3	hard	35	5	0.00	31	@	650	0
							0.66				

Combined level of noise exposure at receptor from all noise sources (dBA): **34.3**

Computation of the attenuated noise level is based on the equation presented on pg. 12-3 and 12-4 of FTA 2006.

Computation of the ground factor is based on the equation presentd in Figure 6-23 on pg. 6-23 of FTA 2006, where the distance of the reference noise leve can be adjusted and the usage factor is not applied (i.e., the usage factor is equal to 1).

Summation of noise levels from different stationary noise sources at the same receptor is based on the equation presented on page 2-3 of FTA 2006.

Sources:

Federal Transit Association (FTA). 2006 (May). Transit Noise and Vibration Impact Assessment. FTA-VA-90-1003-06. Washington, D.C. Available: <http://www.fta.dot.gov/documents/FTA_Noise_and_Vibration_Manual.pdf>. Accessed: March 5, 2020.

Addition of Noise Levels from Multiple Sources at a Discrete Receptor

OBJECTIVE: This work sheet is designed to estiamte the combined level of noise exposure at a single discrete receptor from multiple point sources.

KEY:
- Orange cells are for input.
- Grey cells are intermediate calculations performed by the model.
- Green cells are data to present in a written analysis (output).

Receptor Name: **Houses on Fostoria Street, North of the project site**

STEP 1: Identify the noise sources and enter the reference noise levels (dBA and distance).
Hour of Day (24-HR time)
STEP 3: Select the distance to the receptor and the reduction provided by any intervening barrier.

Step 1.				Step 2.				Step 3.			
Noise Source	**Reference Noise Level**			**Attenuation Characteristics**				**Attenuated Noise Level at Receptor**			
	Reference Noise Level (dBA)	@	Reference Distance (ft)	Ground Type (soft/hard)	Source Height (ft)	Receiver Height (ft)	Ground Factor	Noise Level (dBA)	@	Distance to Receptor (ft)	Reduction Provided by Barrier, if any (dBA)
HVAC Unit	78.0	@	3	hard	35	5	0.00	56.9	@	34	0
HVAC Unit	78.0	@	3	hard	35	5	0.00	56.9	@	34	0
							0.66				
							0.66				
							0.66				

Combined level of noise exposure at receptor from all noise sources (dBA): **59.9**

Computation of the attenuated noise level is based on the equation presented on pg. 12-3 and 12-4 of FTA 2006.

Computation of the ground factor is based on the equation presentd in Figure 6-23 on pg. 6-23 of FTA 2006, where the distance of the reference noise leve can be adjusted and the usage factor is not applied (i.e., the usage factor is equal to 1).

Summation of noise levels from different stationary noise sources at the same receptor is based on the equation presented on page 2-3 of FTA 2006.

Sources:

Federal Transit Association (FTA). 2006 (May). Transit Noise and Vibration Impact Assessment. FTA-VA-90-1003-06. Washington, D.C. Available: <http://www.fta.dot.gov/documents/FTA_Noise_and_Vibration_Manual.pdf>. Accessed: March 5, 2020.

Attenuation Calculations for Stationary Noise Sources

KEY: Orange cells are for input.
Grey cells are intermediate calculations performed by the model.
Green cells are data to present in a written analysis (output).

STEP 1: Identify the noise source and enter the reference noise level (dBA and distance).

STEP 2: Select the ground type (hard or soft), and enter the source and receiver heights.

STEP 3: Select the distance to the receiver.

Noise Source/ID	**Reference Noise Level**			**Attenuation Characteristics**				**Attenuated Noise Level at Receptor**			
	noise level (dBA)	@	distance (ft)	Ground Type (soft/hard)	Source Height (ft)	Receiver Height (ft)	Ground Factor	noise level (dBA)	@	distance (ft)	
HVAC (2 units)	81.0	@	3	hard	8	5	0.00	26.7	@	1550	
HVAC (2 units)	81.0	@	3	hard	8	5	0.00	26.7	@	1550	
Pumps (three combined)	78.8	@	3	hard	8	5	0.00	32.1	@	650	
											-12.0
											-12.0

Notes:

Estimates of attenuated noise levels do not account for reductions from intervening barriers, including walls, trees, vegetation, or structures of any type.

Computation of the attenuated noise level is based on the equation presented on pg. 176 and 177 of FTA 2018.

Computation of the ground factor is based on the equation presentd in Table 4-26 on pg. 86 of FTA 2018, where the distance of the reference noise leve can be adjusted and the usage factor is not applied (i.e., the usage factor is equal to 1).

Roll up door: 73.5 lmax/67.8 leq added 3X, assuming 3 doors at same time

Sources:

Federal Transit Association (FTA). 2018 (September). Transit Noise and Vibration Impact Assessment. Washington, D.C. Available: <http://www.transit.dot.gov/sites/fta.dot.gov/files/docs/research-innovation/118131/transit-noise-and-vibration-impact-assessment-manual-fta-report-no-0123_0.pdf>Accessed: March 5, 2020.
Parking lot reference Lmax level obtained by Ascent Environmental in 2014 during preparation of the Village At Squaw Valley Specific Plan EIR (Placer County 2014)

Appendix J

Stormwater Investigation Technical Memorandum

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MEMORANDUM

To:	Scott Woody, CBO, CASp, DBIA, CM-Lean, LEED-AP – Cal Maritime Academy
From:	Bryn Evans, CPSWQ, and Shannon Brown, PE, QSD - Dudek
Subject:	Stormwater Investigation Technical Memorandum
Date:	August 26, 2022
Attachment(s):	Attachment 1 – Drainage Areas and Stormwater Infrastructure Attachment 2 – Site Investigation Photo Log

The following memorandum is intended to document existing stormwater infrastructure and potential improvements to reduce flooding risk at the California State University Maritime Academy (Cal Maritime or CMA) in Vallejo, California. Following multiple flooding events in Parking Lot A near the CMA Administration Building documented back to 2013, CMA engaged Dudek to review existing hydrology reports, storm drain infrastructure drawings, and conduct a site visit to gain insight into potential causes of the flooding and provide high-level improvement project recommendations. The information provided in this memorandum is a culmination of infrastructure documentation and as-built plan research, site investigation findings, and discussion with CMA staff.

Flooding in Parking Lot A at the Administration Building (Date: 2020[1])
[1]*Editors note: Date estimated; to be confirmed prior to report finalization.*

1 History of Cal Maritime Academy

The Cal Maritime Academy is situated on a 92-acre waterside campus in Vallejo, California next to Morro Cove at the northern end of the San Francisco Bay. CMA was originally named the California Nautical School and was located in Tiburon, California. In 1940, CMA changed its name to the California Maritime Academy, and in 1943, relocated to the current site (67-acres at the time) adjacent to Morro Cove in Vallejo. The site had previously been used as a ferryboat terminal, and portions of the existing infrastructure including storm drain facilities were retained. CMA has since expanded its footprint in the surrounding area to 92-acres, and in 1995, joined the

California State University. Today the CMA campus has nearly 1,000 students and includes classrooms, administration buildings, training facilities, and on-site housing.

2 Existing Hydrology and Stormwater Infrastructure

The Cal Maritime campus is located north of Morro Cove on the San Francisco Bay, west of Interstate 80 (Caltrans right of way), and southeast of the Carquinez Heights neighborhood in Vallejo, California. Hydrology in the area is generally ephemeral surface runoff that is collected in storm drains and conveyed to outfalls into the San Francisco Bay. Previous information identified two drainage areas upstream of the Administration Building where flooding has occurred. Figure 1 presents an overview of the two drainage areas and Attachment 1 shows the approximate location of major storm drain network features and landmarks within each drainage area.

Figure 1. CMA Drainage Areas Upstream of the Administration Building

The combined drainage area upstream from the Administration Building is approximately 170 acres and includes a network of surface drainage features, channelized above ground conveyances (e.g., gutters, natural channels, and ditches), underground conveyances (pipes), and outfalls into the San Francisco Bay. Two primary branches of the storm drain network parallel Maritime Academy Dr. and collect runoff upstream of the Administration Building, dividing the larger drainage area into two main drainages. For the purpose of this memorandum, the two main drainage areas are designated as west or east of Maritime Academy Dr. The drainage areas and their respective storm drain networks combine into a 48" reinforced concrete pipe (RCP) southeast of the Administration Building and go across the lower campus into San Francisco Bay. The lower campus has additional local storm drains; however, these are smaller drains with dedicated outlets into San Francisco Bay and would not contribute to flooding seen upstream of the Administration Building. Therefore, the lower campus storm drains were considered but not evaluated in this memorandum.

Storm drains at CMA were originally installed and maintained by the Vallejo Sanitation and Flood Control District. Ownership and maintenance responsibility was transferred to CMA when the campus was purchased in 1943. Due to the history of various uses and owners of the campus property, original as-built drawings are not available for the storm drains. Therefore, the location and configuration of stormwater infrastructure at CMA is estimated based on road improvement plans (1960), sewer force main relocation plans (1995), plans from various developments around campus, and the July 2022 site investigation.

2.1 West Drainage Area Overview

The drainage area upstream of the Administration Building and west of Maritime Academy Drive is a 75 acre watershed that collects stormwater from the Carquinez Heights neighborhood, adjacent campus property, and portions of the Caltrans right of way. The area is undeveloped hillsides with dense trees/vegetation or high grasses and weeds, low and medium density residential land use, Bodner Field, McCallister Hall, and Caltrans right of way including a small drainage area east of Interstate 80. Runoff in this area is predominantly overland flow that goes towards curb lines and smaller storm drains and lead down to the storm drain branch west of Maritime Academy Dr.

The branch of the storm drain network west of Maritime Academy Dr. is a series of aboveground and belowground conveyances that originate at the CMA pool complex with two biofiltration basins that connect underground to a pipe within the southbound shoulder of Maritime Academy Dr. From the CMA pool complex, the storm drain transitions between belowground and aboveground conveyance four times along Maritime Academy Dr. before connecting to the 48" RCP southeast of the Administration Building. The aboveground conveyances include significant sections of earthen ditches, and the last approximately 500 feet of ditch are elevated on the hillside above Maritime Academy Dr. before flowing into an inlet that connects into the underground network. Caltrans runoff is conveyed to energy dissipators at three separate locations along Maritime Academy Dr. before connecting to this branch of the storm drain network.

2.2 East Drainage Area Overview

East of Maritime Academy Dr. is a 95 acre drainage area that includes Interstate 80 and the hillsides above and below Interstate 80. The runoff from Caltrans right of way (including the hillsides above) is conveyed through storm drains to energy dissipators that connect to CMA storm drains along Maritime Academy Dr. Aside from the interstate roadway surface, the east drainage area is predominantly undeveloped steep slopes with grasses/weeds and a few trees. Historically the area had large trees and other dense vegetation, however, a fire in 2019 burnt much of this vegetation and dead trees were cut down and removed.

This branch of the storm drain network collects Caltrans stormwater discharges through an aboveground connection behind the Maritime Memorial Park on Maritime Academy Dr. and through an above ground connection on Upper Service Rd. This storm drain network is primarily surface inlets to below ground conveyances with a few small sections of earthen ditches at the Caltrans energy dissipator connection points.

3 Stormwater Investigation Discussion

On July 12, 2022, Dudek met on site with CMA staff to conduct an investigation of the storm drain network and gather information to help evaluate potential causes for previously observed flooding near the Administration Building. Dudek and CMA staff walked the campus to locate and inspect stormwater infrastructure including connection points from Caltrans storm drains. Items considered during the investigation include storm drain alignment, condition issues, sources of dry weather flow, and general watershed condition. The following sections summarize the key components of the investigation used to develop the drainage improvement recommendations and Attachment 2 presents photos of these key components.

3.1 Stormwater and Dry Weather Flow Sources

Dry weather flow was observed in multiple locations throughout the CMA storm drain network. Flowing water was observed in the storm drain branch west of Maritime Academy Dr from the bioretention basins adjacent to the CMA pool complex, down to the 48” RCP by the Administration Building. The exact source of this dry weather flow is unknown; however, each connection point from the bioretention basins to the 48” RCP was investigated to assess which drainage area(s) may be contributing flows. Downhill from the bioretention basins, no additional sources of flowing water were observed entering the storm drain network. Since flowing water entering the system was only observed near the CMA Pool Complex, the likely source of the dry weather flow is from the CMA Pool Complex and/or an undocumented storm drain connection from the portion of the Carquinez Heights neighborhood in the drainage area upstream of the basins.

The observed dry weather flow likely does not limit capacity of the storm drain network during rain events. However, the dry weather flow has contributed to impediments to system function in the earthen ditch upstream of Parking Lot A. Dense riparian vegetation is present within and along the earthen ditch including reeds and willows which has reduced conveyance capacity for storm flows and can dislodge during high flow events. Additionally, flows in the ditch have breached a low point between Residence Hall Rd Parking Lot A resulting in flows over the bank down into the adjacent grass area along the and westside of Maritime Academy Dr. As a result of this breach, the grass area has become saturated and limits maintenance capabilities.

3.2 Existing Infrastructure Condition

The existing stormwater infrastructure at CMA varies from fairly new construction to original construction estimated to be 80+ years old. An existing condition assessment was limited to surface observations with additional input from select inlet and manhole locations that were opened during the site visit. The highest priority condition observations are listed below. Figure 2 presents a map of the observation locations.

1. Connection points from Caltrans storm drains to CMA storm drains occurs at energy dissipator structures that appear to be in fair condition, however, the condition of the underground connection points to the CMA storm drain are unknown and should be evaluated. See Attachment 2, Photo 1.

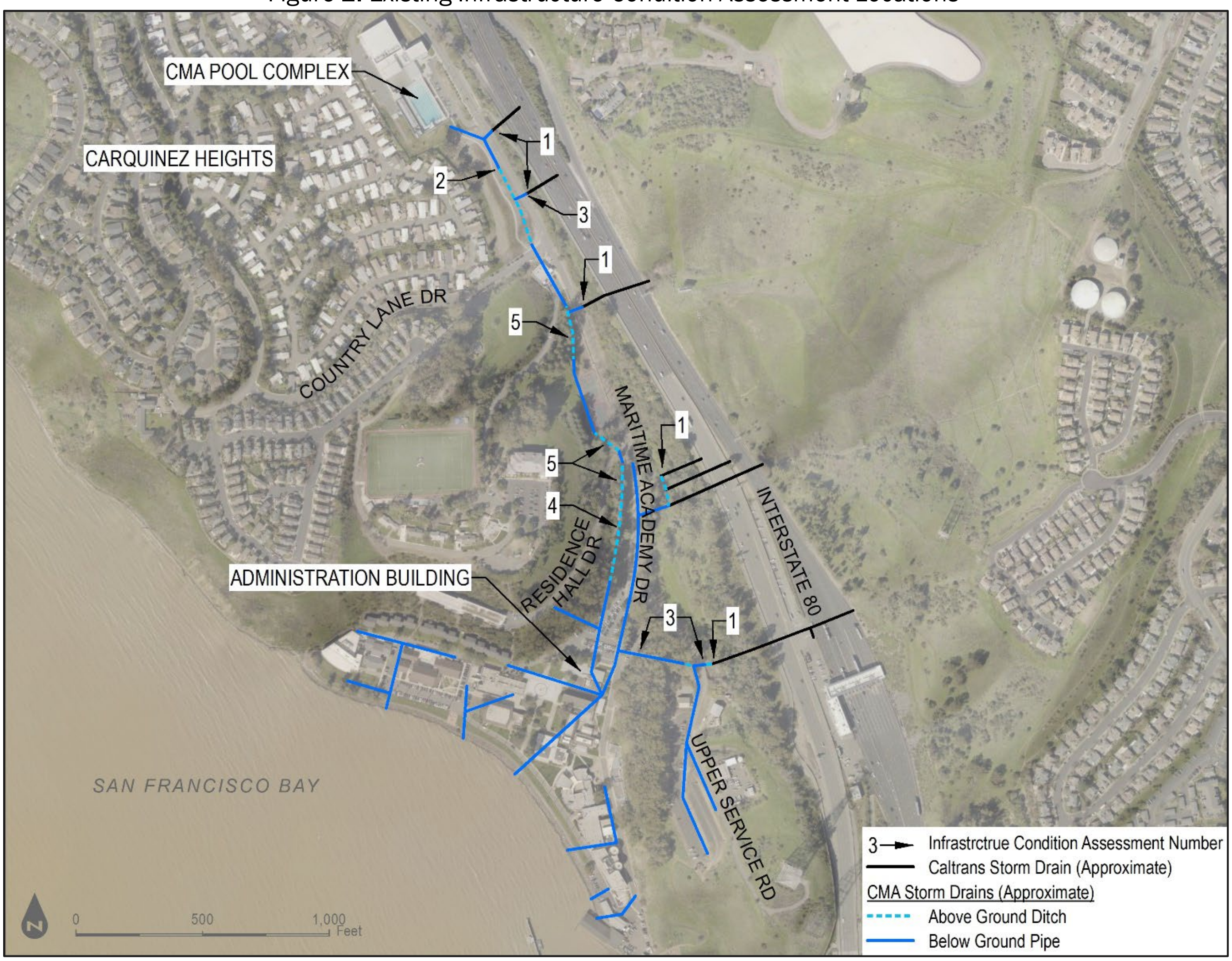
2. A storm drain pipe daylights into a ditch along Maritime Academy Dr between the CMA pool complex and Country Lane Dr. The edge of the pipe chipped, and 3 to 5 feet of the pipe are exposed at the discharge point. See Attachment 2, Photo 2.

3. Numerous inlets along Maritime Academy Dr. and Upper Service Rd. appear to be completely clogged with sediment and may not be functional. See Attachment 2, Photo 3 and 4.

4. The elevated earthen ditch south of Residence Hall Rd. and north of Parking Lot A is breached on the east bank at a low point and discharges flow (including dry weather flow) into the adjacent grass area along Maritime Academy Dr. The lower grass area is saturated and can no longer be routinely maintained. See Attachment 2, Photo 5 and 6.

5. The earthen ditches along Maritime Academy Dr. have significant plant growth likely due to the present of water throughout the year. Aside from the low point issue mentioned above, the ditches appear to be in fair condition, however, the vegetation growth may limit capacity and contribute towards overflows during high flow events. See Attachment 2, Photo 7.

Figure 2. Existing Infrastructure Condition Assessment Locations



Condition of the visible above-ground storm drain network overall appears to be fair and no major defects were observed aside from the breach in the elevated ditch (No. 4 above). However, a detailed, subsurface investigation of the storm drain network is recommended before moving forward with any drainage improvements.

3.3 Stormwater Infrastructure and Capacity Evaluation

During the site investigation, Dudek and CMA staff evaluated the visible storm drain infrastructure and surrounding drainage areas to see if there are visible indicators of stormwater conveyance capacity issues that could lead to flood risks similar to previous incidence recorded in Parking Lot A upstream of the Administration Building. Previous flooding is documented back to 2013[1], and additional flooding in this area was observed in 2019[2] and 2021[2]. The following list provides a summary of the observations:

- CMA staff have observed the elevated earthen ditch west of Maritime Academy Dr. overflowing onto the adjacent grass area during storm events. The overflow makes its way down across Parking Lot A and contributes to flooding in the low area in from the Administration Building. Although Parking Lot A has grate inlets to collect surface runoff, the amount of additional stormwater from the breached ditch may exceed capacity of the inlets.

- Review of infrastructure drawings indicated a manhole in Parking Lot A was the location for multiple underground connection points. During the site investigation, the manhole was opened, and multiple non-standard taps-ins were observed within the structure which indicates they were likely connected after the manhole was installed and potentially not considered in the original storm drain capacity analysis.

- Investigation of the storm drain network above the elevated earthen ditch and connection points from Caltrans along Maritime Academy Dr. have not previously overflowed or show signs that flooding has occurred. Additionally, flooding has not occurred in the lower campus downstream of the 48" RCP which suggests there is a bottleneck upstream of the 48" RCP that may be the cause of flooding.

- The fire in 2019 and subsequent vegetation clearing performed by Caltrans and CMA has left the majority of the hillside east of Maritime Academy Dr. as well as the hillside above Interstate 80 cleared of brush and trees. Historically, this area has had mature and dense vegetation and is now mostly high grasses and weeds. This type of land cover change can often increase runoff and erosion and can overload downstream storm drains designed for smaller flows. Preliminary estimates using runoff coefficients in the Solano County Hydrology Manual suggest the fire-induced change in vegetation cover may have resulted in an approximately 10-20% increase in surface runoff during storm events. While no signs of recent erosion were observed in the burn area and the hillside east of Interstate 80, more detailed hydrology and hydraulic modeling of the watershed is needed to fully assess wet weather conveyance capacity of the existing storm drain system and identify system limitations.

[1] Utility Infrastructure Systems Failure Analysis and Impact Assessment (Draft Report). Hard copy excerpt provided by CMA staff.
[2] *Editors note: Dates estimated; to be confirmed prior to report finalization.*

4 Recommended Drainage Improvements

The following recommendations were prepared based on outcomes from the site investigation, review of CMA infrastructure drawings and previous reports, and discussions with CMA staff. The recommendations are preliminary and subject to change following a more detailed evaluation of the storm drain alignment and capacity analysis.

4.1 Maintenance of Existing Infrastructure

Portions of the existing storm drain network appeared to have condition issues that may impact system capacity and/or indirectly limit CMA staff's ability to perform routine maintenance. Maintenance recommendations are constrained to the visible aboveground infrastructure that was observed during the site investigation. Prior to any future belowground investigation, it is recommended that CMA have the storm drains hydro-flushed to remove potential buildup of sediment or debris that may obscure inspection.

- The condition of underground infrastructure including catch basins, pipes, and junction structures was not investigated as part of this project, therefore it is recommended that CMA perform a closed-circuit television (CCTV) survey to establish a comprehensive assessment of the network's condition. CCTV surveys will also allow CMA to verify underground connection points and diameters of assets that were not visible during the field investigation.

- The earthen ditches along the west side of Maritime Academy Dr. have dense riparian vegetation growing along and within the channelized area. Additionally, dense vegetation is growing in the earthen ditches along the east side of Maritime Academy Dr where Caltrans outfalls discharge. Vegetation in and around the ditches can reduce flow capacity and/or become debris that gets caught at inlet locations downstream. It is recommended that CMA routinely clear vegetation from within the ditches and trim back the banks to maximize storm flow conveyance capacity. Note, trimming and removal of vegetation in waterways and environmentally sensitive areas may require environmental permits from local, state and federal agencies.

- The elevated earthen ditch between Residence Hall Rd. and Parking Lot A has a low point on the left bank that allows stormwater and dry weather flow to flow into the adjacent grass area. This low point results in maintenance issues for the grass area and likely contributes to flooding in Parking Lot A. It is recommended that the left bank along the elevated ditch be raised and armored to prevent overtopping and protect it from potential future erosion.

- Multiple Grate inlets along Maritime Academy Dr. and Upper Service Rd. appeared to be clogged with sediment. Some inlets appear to be 100% clogged and are unable to convey flow. It is recommended that all grate inlets be routinely inspected and maintained as needed.

4.2 Detailed Investigation of Storm Drain Locations and Capacity Analysis

The potential storm drain capacity issues identified in this memorandum are based on preliminary information and have not been evaluated through a detailed engineering process. Any potential changes to storm drain infrastructure, including addition of new storm drains, should follow a survey and modeling of the existing system.

It is recommended that CMA conduct a detailed analysis of the storm drain system that includes, but is not limited to, the following:

- Perform detailed storm drain infrastructure location and elevation surveys, and survey below ground conveyances, manholes, and catch basins using CCTV. Potholing may be required as part of the detailed survey.

- Delineate an accurate storm drain network using the survey results that incorporates both horizonal and vertical corrections.

- Develop hydrology and hydraulics models that calculate surface runoff and storm drain system capacity based on Solano County and City of Vallejo hydrology and drainage design standards. Surface runoff should be calculated at the individual catchment level to provide the necessary resolution needed to make justifiable recommendations for new or improved infrastructure.

Once the storm drain network has been fully surveyed, evaluation of system capacity compared to the design and/or previously observed storm events should identify potential system deficiencies. Potential options for managing capacity deficiencies include flood control basins or structures, increased storm drain capacity with larger infrastructure, and/or realignment of storm drain infrastructure to increase hydraulic efficiency. No new or realigned infrastructure is recommended until a detailed survey of the storm drain is prepared and potential system deficiencies are documented.

4.3 Collaboration with Caltrans on Water Quality/Flood Control Management Projects

Where Caltrans outfalls onto CMA property presents an opportunity for the two organizations to collaborate on multi-benefit water quality treatment and flood control projects. Currently, Caltrans outfalls are directly connected to the CMA storm drain or travel through short ditches before entering the storm drain. Diverting and treating all or some portion of Caltrans runoff would provide two main benefits: 1) diverting and treating the runoff would help reduce flood risk by slowing down runoff into the CMA storm drains, and 2) treating the runoff would provide Caltrans an opportunity to contribute towards broad state-wide stormwater treatment goals. Additionally, CMA would be contributing towards reducing stormwater pollutants from entering the San Francisco Bay.

Stormwater best management practices (BMPs) are structural and non-structural stormwater management techniques designed to remove or prevent pollutants in stormwater. Structural BMPs such as bioretention/detention/infiltration basins, vaults, and infiltration galleries can also provide a level of flood control by capturing runoff and reducing the peak discharge rate. Stormwater treatment and flood control BMP options should consider the targeted pollutants to remove, maximum and minimum flow rates, site constraints, and long-term maintenance requirements. Ideally, a single large BMP at the downstream end of the storm drain would limit maintenance requirements and increase construction efficiency. Considering the limited area along Maritime Academy Dr. to place a large BMP and the long distance between Caltrans outfalls along the road, a combined treatment option for all outfalls is unlikely without significant infrastructure improvements, however, smaller, more localized BMPs can still provide significant water quality treatment and flood risk reduction. The following presents preliminary options for collaborative stormwater treatment BMPs on CMA property:

- Underground stormwater detention and infiltration system in the grass area west of Maritime Academy Dr. uphill from Parking Lot A. This system would be able to divert all or some portion of the stormwater from Caltrans and CMA before flowing to the outfall into San Francisco Bay. Constructability is dependent on detailed H&H, evaluation of underground utilities, and funding sources. The Caltrans outfall on Upper Service Rd. could be routed to the grass area but may require a new storm drain within Upper Service Rd.

- Bioretention/detention/infiltration basin at Caltrans outfalls behind the Maritime Memorial Park. At this location, three Caltrans storm drains come down the slope from Interstate 80 and discharge into an earthen ditch before entering the CMA storm drain. Access to the outfall location is fairly limited and may impact the Maritime Memorial Park. A BMP at this location would not capture runoff from the CMA campus, however, it would reduce flood risk from Caltrans runoff to the lower CMA campus.

- Bioretention/detention/infiltration basin north of Country Lane Dr. on the west side of Maritime Academy Dr. This location has an earthen ditch that conveys stormwater runoff from the CMA pool complex, Maritime Academy Dr. and two Interstate 80 Caltrans outfalls along Maritime Academy Dr. The area naturally flattens out at Country Lane Dr. before entering a culvert under the roadway and has good access from all sides. A WQ BMP at this location may allow for reduction or elimination of dry weather flows downstream that have impacted maintenance of the grass area. Ancillary benefits may include restoration of a currently relatively barren area with native vegetation.

- Underground stormwater detention and infiltration system in Parking Lot A. This BMP would require nearly complete removal and replacement of the parking lot, as well as potential realignment of other utilities that traverse through the area. Feasibility for implementation of a underground detention/infiltration BMP at this location is dependent on numerous site opportunities and constraints not assessed as part of this initial evaluation and likely will require collaboration with other campus wide infrastructure initiatives that would independently require reconfiguration of the parking area. Potential benefits of the project include flood risk reduction with large volume underground chambers, treatment of all Caltrans outfalls and most of the stormwater runoff from CMA, and realignment/replacement of old storm drains.

5 Conclusion

Cal Maritime has experienced flooding upstream of the Administration Building in Parking Lot A that has caused damage to the building and surrounding around. Dudek and CMA staff performed a preliminary desktop and field level investigation of the storm drain network to help identify potential causes for the flooding, general system and watershed condition, and develop recommendations for projects the help reduce the risk of flooding in the future. The results of this study present potential proactive on-going routine maintenance and capital improvement project planning measures for CMA consideration. Because CMA receives and conveys Caltrans runoff, there are potentially options to collaborate on stormwater BMP projects that provide flood risk reduction and water quality enhancements for both organizations. The stormwater management concepts and ideas presented in this memorandum are preliminary in nature and require precise survey of aboveground and below ground assets to verify findings.

Attachment 1

Drainage Areas and Stormwater Infrastructure

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REPLACE PAGE WITH PDF MAP

Attachment 2
Site Investigation Photo Log

 Photo 01	 Photo 02
Energy dissipator along Maritime Academy Dr. Outlet pipe flows into a grate inlet that connects to a pipe under the road.	Discharge pipe from bioretention basins adjacent to CMA pool complex into a ditch along the west shoulder of Maritime Academy Dr.
 Photo 03	 Photo 04
Grate inlet along Upper Service Rd. clogged with sediment.	Storm drain inlet adjacent to Parking Lot B clogged with sediment and debris.

 Photo 05	 Photo 6
Looking upstream at the breached section (right side of picture) on the elevated ditch west of Maritime Academy Dr. Gravel bags have previously been used as temporary protection.	Flowing water at bottom of grass area west of Maritime Academy Dr. from the breach in the elevated ditch.
 Photo 07	 Photo 08
Trees and vegetation growing on the banks of elevated earthen ditch near Parking Lot A.	Inlet at bottom of the elevated ditch that leads to Parking Lot A upstream of the Administration Building, and ultimately to the 48” RCP outfall to San Francisco Bay.

 Photo 09	 Photo 10
Grate inlets in Parking Lot A in front of the administration building upstream of the 48" RCP outfall to San Francisco Bay.	View into manhole where the two main branches of the storm drain network combine into the 48" RCP. Note flowing/standing water.
 Photo 11	 Photo 12
Lower bioretention basin adjacent to the CMA pool complex. Flowing water was observed in the catch basin at this location.	View uphill from the upper bioretention basin showing the CMA pool complex wall.

 Photo 13	 Photo 14
Flowing water into and out of the lower bioretention basin catch basin.	Conveyance from Interstate 80 that outfalls to a Caltrans retention basin along Upper Service Dr. Discharge from the basin flows under Upper Service Dr. into the CMA storm drain.
 Photo 15	
Caltrans retention basin along Upper Service Dr.	